Tecticornia Review

Ten Mile and Lake Sunshine

This report was prepared for:

Kalium Lakes Potash Pty Ltd

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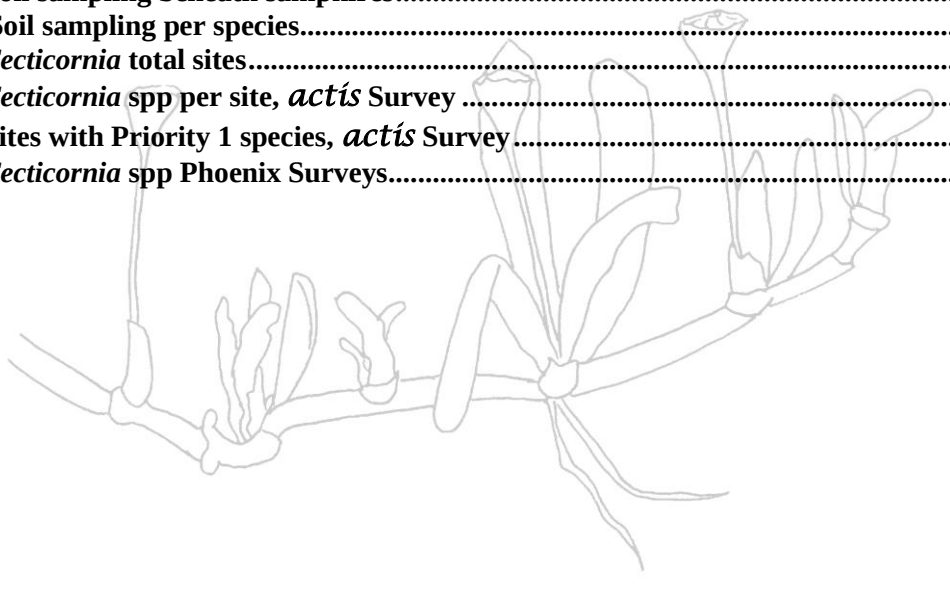

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1 Executive Summary

On the 16th and 17th October 2018 Bindy Datson and Mark Coleman of *actis* visited the Kalium Lakes Potash Pty Ltd site at Ten Mile Lake and Lake Sunshine in the Little Sandy Desert. The visit was in response to requests by the Environmental Protection Authority (EPA) to Kalium for further studies of the fringing vegetation (samphires) of these lakes which in their opinion had not been sampled adequately with many 'sterile' samples and some unidentified specimens.

The site visit by *actis* was over two days and covered about 500km using a helicopter for ease and speed of sampling. Before the site visit, documentation on the site was studied to become familiar with species likely to be found. This was difficult as some of the species had working names only and no formal references to be found in the Herbarium Florabase. Phoenix Environmental had collected four Priority 1 species during their surveys.

A map was provided by Preston Consulting with lakes of interest marked, which was used to navigate to the various sites. At each site a GPS co-ordinate was taken, the species described and identified where possible and a small sample taken for later identification if field identification was not possible. Photographs were taken at each site. Walking transects along and away from the shore were completed at sites on Ten Mile Lake and Lake Sunshine, spot sampling of different samphire communities was carried out elsewhere.

Several samples of soils from beneath plants were taken to compare with the known database to indicate salinity and moisture in the root zone.

Twenty-two different regions across fifteen lakes were surveyed which included six sites on Ten Mile Lake, three on Lake Sunshine, eleven sites were at wetlands around the two main lakes and the other two at lakes further north.

In answer to EPA concerns, maps have been generated from the *actis* survey showing all Waypoints where Priority species were found. Descriptions of the extent of the communities containing these species have been recorded (see from page 31) but more sampling and ground-truthing would be needed to accurately map these communities which are extensive, especially on Ten Mile Lake. Similarly, it is difficult to estimate the number of individuals within a community without further extensive ground-truthing.

Maps showing all Waypoints visited have been generated to indicate the areas searched for differing samphire communities (see from page 109).

Recommendations have been made as to the placement and number of monitoring transects, to cover possible influences from mining activities (see Summary of Recommendations, page 19).

2 Introduction

Kalium Lakes Potash Pty Ltd (Kalium) is proposing to extract Sulphate of Potash (SoP) from surficial aquifer hypersaline brine and brine from deep hypersaline paleochannel aquifers. Kalium has mining leases over the eastern end of Ten Mile Lake and a lake further to the north east, Lake Sunshine.

Ten Mile Lake (4,527 ha) and Lake Sunshine (2,945 ha) are large episodic saline lakes 165km south east of Newman and are situated in the Little Sandy Desert, an area which has had low levels of study, especially in comparison to the Goldfields regions, which have been extensively studied in the course of gold and other mineral exploration and mining.

Ten Mile Lake and Lake Sunshine are expressions of the paleodrainage system below them and they are associated with smaller lakes and wetlands, many of which are not hydrologically connected to the larger lakes, however some of these may occasionally overflow into the larger lakes after large rain events.

In the course of obtaining environmental approval to begin mining, Kalium employed Preston Consulting Pty Ltd (Preston) to organise Vegetation and Fauna studies to meet the EPA's requirements. Preston contracted Phoenix Environmental Sciences (Phoenix) to carry out among other things a vegetation survey of the mine lease envelopes.

Phoenix carried out extensive vegetation studies of the areas and in the course of those studies several previously unidentified species of samphire (succulent lake-fringing sub-shrubs) were found as well as Tecticornia species with a Priority 1 designation.

The EPA expressed concerns with the number of unidentified Tecticornia species and the Priority 1 species and requested further studies among other items.

Actis Environmental Services (*actis*) were asked to carry out a samphire study as an adjunct to the studies already carried out by Phoenix.

Due to time constraints *actis* were able to allocate only two days in the field, transported from site to site by helicopter. In that time twenty-two different sites were visited which included six sites on Ten Mile Lake, three on Lake Sunshine, eleven sites were at wetlands around the two main lakes and the other two at lakes further north.

2.1 Client details

Preston Consulting Pty Ltd for Kalium Lakes Potash Pty Ltd (Kalium)

3 Scope of Work

- Review the current documentation on samphires in the project area and become familiar with species likely to be found in the region.
- At each site the samphires are to be recorded and sampled if the identification is in doubt. Photographs, general description and GPS co-ordinates will be recorded. Walking transects along and away from the shore will be completed in order to complete the survey.
- Several samples of soils from the roots of plants will be taken to compare with the known database. This will give us an idea of the salinity of the water in the root zone.

4 Review of Current Documentation of Surveys Associated with Samphire Vegetation in Project Area

4.1 Vegetation, Fauna and Groundwater Surveys Reviewed by actís

- Flora and vegetation survey for the Beyondie Sulphate of Potash Project. Prepared for Kalium Lakes Potash Pty Ltd, February 2018, Phoenix Environmental Sciences.
- Flora, vegetation and fauna survey for the Beyondie Sulphate of Potash Project Concentrator Lakes. Prepared for Kalium Lakes Ltd, June 2018, Phoenix Environmental Sciences.
- Beyondie Sulphate of Potash Project Surface Water Assessment, 16 April 2018, Advisian, Worley Parsons Group
- Beyondie Potash Project – Ten Mile and Lake Sunshine Hydrogeological Assessment of Brine Abstraction, 21/12/2017, Advisian, Worley Parsons Group

There had been a previous CALM survey of the Little Sandy Desert, but this barely covered the Project area (Van Leeuwen 2002).

Other Studies of the Little Sandy Desert and other relevant information can be found in the references section in the above publication and point to studies carried out in the Little Sandy Desert over time since 1965.

In the course of obtaining Environmental Approval to begin mining, Kalium engaged Preston to organise Vegetation and Fauna studies to meet the EPA's requirements (EPA 2016). Kalium Lakes contracted Phoenix Environmental Sciences (Phoenix) to carry out among other things a vegetation survey of the likely disturbance envelopes.

Phoenix's samphire study was extensive at the Beyondie Lakes, the three small lakes to the south west of Lake Sunshine (named for the purposes of the *actís* study Vegetated Lake #1, Vegetated Lake #2 and Sunshine Concentrator Lake) and the small lake to the east of Ten Mile Lake (Ten Mile Concentrator Lake). Studies also were done by Phoenix at Lake Sunshine and the northern portion of Ten Mile Lake where the proposed stockpile will be located.

In the course of those studies some Tecticornia species were collected that had Priority 1 designation and some with working names as they have not yet been described. Due to the time of collection many samples were collected that were sterile – no seeds or flowers allowing identification.

"*Four conservation significant flora were recorded within the study area, all Priority 1 Tecticornia species:*

• Tecticornia globulifera
• Tecticornia sp. Christmas Creek *(K.A. Shepherd et. al. KS 1063)*
• Tecticornia willisii
• Tecticornia sp. Sunshine Lake *(K.A. Shepherd et al. KS 867).*

Two unidentified taxa collected, Tecticornia sp. nov. 1 (aff. pruinosa/ laevigata) and Tecticornia sp. nov. 2 (aff. pruinosa/undulata), potentially represent undescribed taxa and therefore may be considered locally significant as they exhibit anomalous features." **(**Flora and vegetation survey for the Beyondie Sulphate of Potash Project, Phoenix February 2018)

5 Samphires – conservation and groundwater-dependency

5.1 Palaeodrainage Systems in the Little Sandy Desert

"The Little Sandy Desert is biologically a poorly known natural region in north-western Australia. The Desert experiences an arid tropical climate typified by hot summers and cool winters with mostly summer rainfall which averages 200 mm to 250 mm per annum. The salient characters of the Desert are resistant sedimentary uplands of mostly sandstone rising above extensive rolling eolian red sand dunes and sand plains. Significant uplands, typified by the Carnarvon Range are present, however relief is generally subdued. Drainage is mostly internal, easterly to north-easterly trending and along paleodrainage channels. The Desert is situated upon several geological structures most of which are Precambrian sedimentary basins. The Savory Basin is the most important of these sedimentary features and is completely encompassed within the Desert. Overlaying these sediments are Cainozoic deposits dominated by eolian sands although numerous examples of calcariferous, gypsiferous and lateritic deposits are also present. The Desert is mainly vegetated by Acacia, Grevillea *and ericoid shrubs over hummock grasses although not insignificant woodlands of* Eucalyptus, Allocasuarina *and* Acacia *persist.* Melaleuca *and samphire heaths dominate most of the drainage features. The majority of the region is Unallocated Crown Land, although some parts of the Desert are within well-known reserves such as the Rudall River National Park and Canning Stock Route. At this time the region has limited financial prowess although the potential for hydrocarbons in the Savory Basin and the significant mineralisation associated with the Paterson Orogen in the Rudall River area may alter this situation in the future."*

"Drainage in the Desert is principally internal, trending east to north-east into Lake Disappointment, saline and associated with paleodrainage channels. Exceptions to this flow pattern are associated with the Rudall River which drains into Lake Dora, the Oakover River which is part of the De Grey River catchment and Jigalong Creek which is part of the Fortescue River catchment. In the south drainage on the southern side of the Carnarvon Ranges is into Lake Naberru and Kahrban Creek. The most prominent drainage feature of the Little Sandy Desert is Lake Disappointment and its associated network of playas and clay pans. Other large lakes include White Lake, Lake Aerodrome, Ten Mile Lake, Terminal Lake, Lake Wilderness and Lake Sunshine. The largest drainage channel in the region is Savory Creek which flows through the middle of the Desert into Lake Disappointment. Ilgarari Creek is another prominent drainage channel which flows into Yanneri and Terminal Lakes. Other paleodrainage channels are associated with the Durba Hills and the Disappointment Paleoriver (van der Graaff et al. 1977, Williams 1992). Numerous springs, soaks and developed wells are located throughout the Desert including Durba Spring, Curran Curran Rockhole, Bullen Well and Wells 11 to 21 along the Canning Stock Route." (Van Leeuwen 2002)

The References section in the above publication point to other various studies carried out in the Little Sandy Desert over time since 1965.

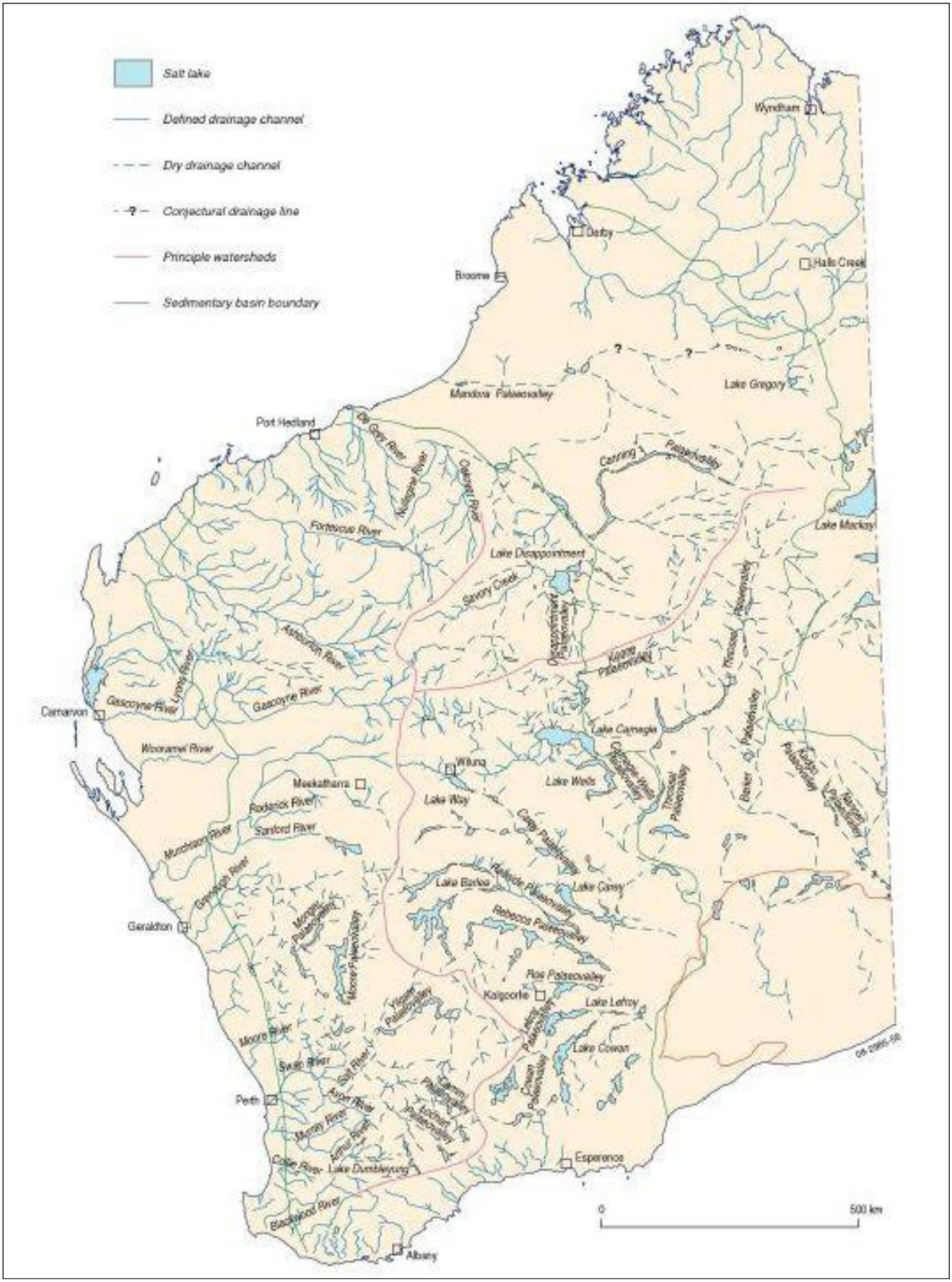

Figure 1 - Palaeodrainage in Western Australia (Magee 2009)

5.2 Samphire zonation and groundwater dependency

Samphires are succulent sub shrubs and shrubs associated with wetlands or periodically inundated damplands. Often the ground they are growing in is saline, though they need fresh water to germinate (Purvis et al. 2009). Following is an extract from 'Understanding Species Zonation of Samphires (Salicornieae) in the Goldfields of Western Australia' (Datson 2002b).

"The saline wetlands of the Goldfields are all linked to ancient drainage systems, or Palaeochannels, which are relics of rivers that used to drain into the Eucla Basin, to the southeast (Johnson et al. 1999). These saline wetlands are predominantly large bare expanses of clay playa surrounded by gypsum or sand dunes and accompanying clay pans. There are some exceptions to this – Lake Raeside is more a series of pans linked by drainage channels than one single lake, for instance. The water in the Palaeochannels is hyper saline; up to 280g/L, however the water on the surface varies from being fresh enough to support tadpoles and Shield Shrimps, to a salt crust.

Samphires are closely associated with these saline lakes and their surrounding clay pans, each species growing in the portion of the lake shoreline or pan that meets its needs (see Figure 2). It is evident that many samphire species have evolved to grow in specific areas, under certain conditions, and are in reality quite fragile and susceptible to change. The species found on lake beaches are often quite different to those found on adjacent Aeolian plateaux or dunes and again on the surrounding fresh water clay pans.

Samphire species appear to have evolved to fill different niches in the environments they inhabit. The individual species grow in their preferred zones. For instance, *Tecticornia indica* subsp. *bidens* is nearly always found in well-drained soils – at Lake Carey, in the northern Goldfields, it is always found at about one meter above the lake playa. *Tecticornia halocnemoides* subsp. *caudata*, on the other hand is rarely found growing more than a few centimetres above the lake playa and is often found out on the waterlogged saline clays. Most Samphire species fall somewhere in between these two extremes, showing tendencies toward one or other end of the scale.

The principal factors that affect species zonation seem to be drainage, or soil moisture, and salt load, or salt concentration. Other factors that affect where a particular species will grow are soil composition (gypsum, sand, limestone or clay) and temperature (tropical species, subtropical species. The other factor that may affect species zonation is pH. Most species sampled were growing in soils with a pH7 or over. Exceptions to this were *T. lylei*, which has only been found in soil with a pH 6, *T. lepidosperma* in soils with a pH 6-7 and *Sarcocornia blackiana* and *Tecticornia disarticulata*, which have been found in soils with a pH 6-8.5."

Observed impacts of dewatering drawdown (at Lake Carey):
Several vegetation (samphire) transects have been monitored annually at Lake Carey since 1999 (B. Datson 1999-2011) and it has been found that the dewatering drawdown effect at one site extended for about 5km of northern shoreline because an arm or bifurcation of the main palaeochannel was dewatered in the course of mine operations. The effects seen were soil mobilisation, both on the lake playa and in the lake dunes expressing as dust storms and during wet periods as gully erosion. Vegetation zonation in the dunes and on the playa changed with samphires moving off the dunes and onto the playa, or close to the edge of the playa. Dune vegetation became dominated by Atriplex and Frankenia species instead. This is an extreme example of dewatering drawdown effect.

Other vegetation transects at Lake Carey that could have been potentially affected by dewatering drawdown have not shown the same effects. Two transects are adjacent to a discharge which would keep the lake sediments damp, negating the drawdown effect. One transect has suffered some drawdown effect with some soil mobilisation but no zonation changes and another does not appear to have suffered any changes at all. The transects with moderate or little drawdown effect are adjacent to minor arms or tributaries of the Carey Palaeochannel, not the main channel.

It has been noted at a number of sites that if a drawdown area on a lake playa is enclosed by a bund, within a year there has been samphire germination – the playa sediments become less saline, allowing germination.

It appears that the mechanical effect of dewatering is a reduction in cohesive forces in the vadose zone which in turn makes the shallow sediments more susceptible to wind erosion, reduction in salinity and subsequent colonisation by more terrestrial species.

Potential Impacts of Salt on Samphires:
In the process of extracting Sulphate of Potash from the Lake brines there will be about 40-50 million tons of Sodium Chloride as a by-product (in the form of harvested crystals) over the proposed life of the mine (see *actís* memo 'Salt Stockpile on Ten Mile Lake' 18.09.2018). As the project site is not close to transport it is not economically viable to sell the salt as a resource, so it has been proposed that it be stored in a stockpile on Ten Mile Lake.

While this would seem to be an obvious solution (salt from the Lake going back onto the lake), ephemeral salt lakes can be quite fresh after large rainfall events with often substantial populations of aquatic invertebrates which in turn feed birds - which somehow know when there is a lake fill. Samphires can survive in saline conditions when they are grown but most need quite fresh water to germinate (Purvis et al. 2009)

Potential impacts of salt on samphires are:

- Physical removal or crushing of plants on lake playa
- Larger rainfall events needed to dilute lake water enough to encourage germination
- Reduced length of time of 'fresh' phase of lake fill to allow juveniles to grow

actís understands that Kalium Lakes intends to construct a bund around the stockpile to address these potential impacts (see Figure 8 for stockpile location).

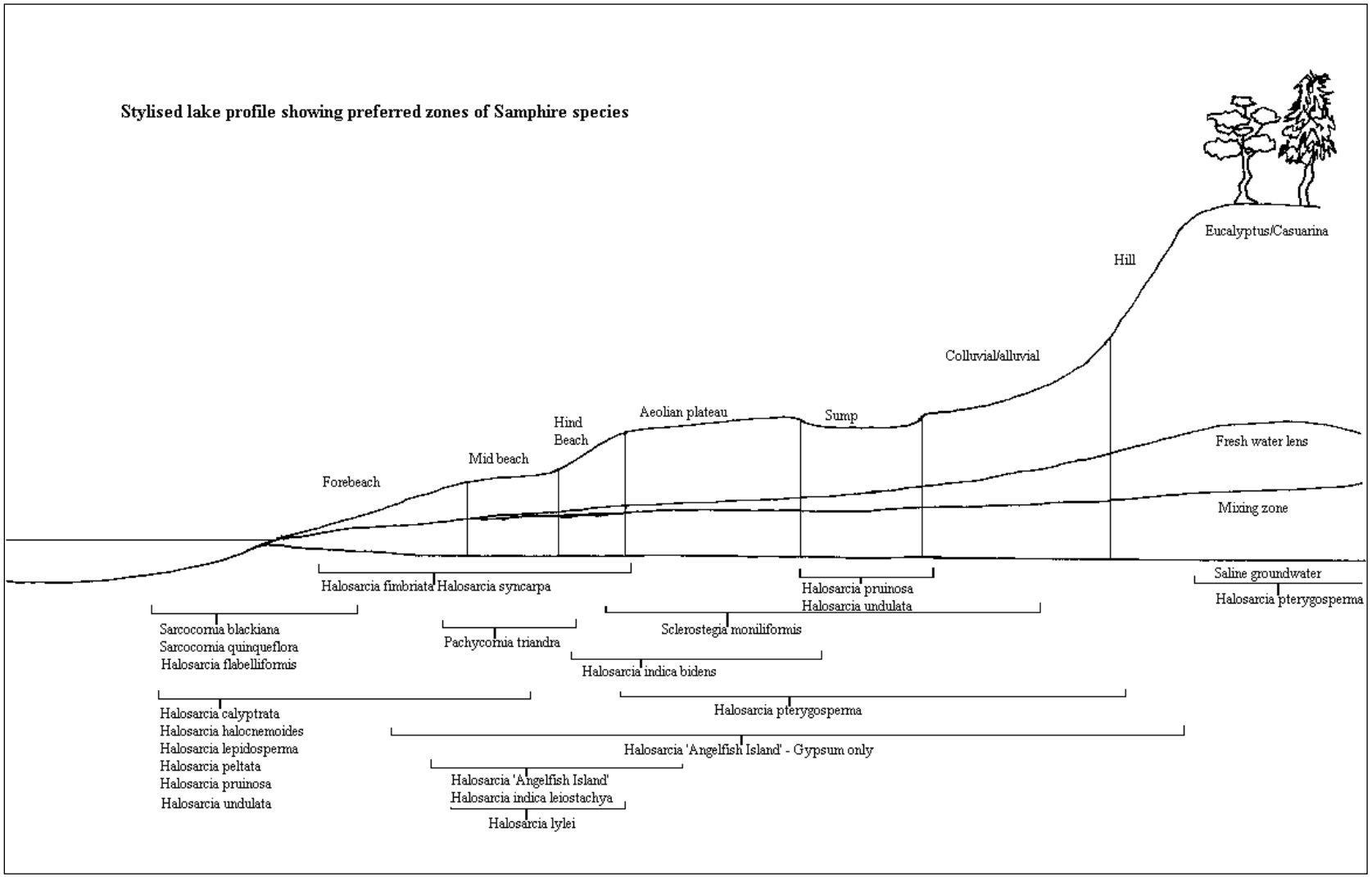

Figure 2 – Stylised lake profile showing preferred zones of samphires – note: *Halosarcia* spp and *Sclerostegia* spp are now *Tecticornia* spp[1]

[1] The figure above was taken from Datson, B. M. (2002a). Samphires in Western Australia A field guide to Chenopodiaceae tribe Salicornieae Department of Conservation and Land Management. and relates to vegetation at Lake Carey, some of which are found in the study area. The profile is relevant to vegetation at other lakes, with different species substituted.

5.3 Samphire Conservation Significance

Samphires are succulent shrubs and sub-shrubs that grow in or around the margins of water bodies, usually saline, where they are able to survive due to the method of storing salts in a vacuole, away from other cell organelles. This gives samphires a competitive advantage as few other plants can live in such saline environments.

The Little Sandy Desert, which is where this study is situated, has not been studied as intensively as, for example, the Goldfields region. There are few roads and until now the area has not attracted mining interests. With the reduction of readily available potash resources, attention has focussed on the large ephemeral salt lakes of inland Australia as a source of sulphate of potash. There is now interest in securing Environmental Approval to extract brine from some of these lakes. As with many of the salt lakes in Western Australia, because of their isolation there is a high degree of endemicity of species. Some of the samphires found at the Kalium prospect have a Priority 1 rating and a few individuals have not been identified and are potentially 'new' or previously undescribed species.

"All listed species are in need of special protection and are declared to be Rare Flora for the purposes of section 23F of the WC Act (Western Australian Government 2015).

The Department of Biodiversity Conservation and Attractions (DBCA) administers the WC Act and also maintains a non-statutory list of Priority Flora species, most recently updated 19 November 2015. Priority species are still considered to be of conservation significance – that is they may be rare or threatened – but cannot be considered for listing under the WC Act until there is adequate understanding of their threat levels. Species on the Priority Flora list are assigned to one of four priority (P) categories, P1 (highest) – P4 (lowest), based on level of knowledge/concern. The Minister for Environment may also list ecological communities which are at risk of becoming destroyed as 'Threatened'4. DBCA maintains a list of ministerially-endorsed TECs as well as a non-statutory list of Priority Ecological Communities (PECs) which are also assigned to one of five categories.

Any activities that are deemed to have a significant impact on listed flora species can trigger referral to the Environmental Protection Authority (EPA) for assessment under the EP Act. The EPA's position on TECs states that proposals that result in the direct loss of TECs are likely to require formal assessment (EPA 2006)." (Flora and vegetation survey for the Beyondie Sulphate of Potash Project Prepared for Kalium Lakes Potash Pty Ltd by Phoenix Environmental)

There have been studies of the flora and fauna of the Little Sandy Desert region, including the Kalium Project area. The samphire studies carried out by Phoenix Environmental were concentrated at the Beyondie Lakes with a few sites at Ten Mile Lake, TML Concentrator Lake, two small vegetated lakes and a few at Lake Sunshine. The project envelope has altered with no work now being carried out at Beyondie Lakes – emphasis is now on Ten Mile Lake initially and ultimately Lake Sunshine, plus portions of two small lakes to be used as concentrator lakes (Ten Mile Concentrator Lake and Sunshine Concentrator Lake).

The EPA has made recommendations for further studies at the project area.

6 Survey Description

On the 16th and 17th of October 2018 Bindy Datson and Mark Coleman of *actís* Environmental Services visited Ten Mile Lake, Lake Sunshine and several smaller lakes over two days using a helicopter to cover about 500 km. Due to time constraints and allowing time for orientation, transects were walked taking GPS waypoints each time the samphire vegetation appeared to change.

The EPA required further surveys of Ten Mile Lake as there have been only three to date. *actís* visited six Ten Mile Lake sites and did walking transects at these sites. Samphires were identified in the field where possible and small vegetative samples were taken for later identification if needed (targeting material with seeds or flowers). There is a high level of confidence that all Tecticornia species in the transects and spot locations have been collected and identified from over the two days of sampling. Zones that appeared different from the air were targeted and sampled. The extent of each zone around the perimeter of the lakes is less well known and therefore the accuracy of the mapping is restricted. The proposed lakes to be impacted were sampled more extensively than the small lakes that are not in the project. These lakes outside of the project were often just checked for specific species.

The south eastern part of the Lake was visited and transected, which was an EPA request. Ten Mile Lake has a large proportion of its playa covered by samphires, unlike Lake Sunshine which has a mostly bare kopi playa with vegetation in invaginations and coves.

Lake Sunshine was visited and three transects were walked using a GPS to mark where vegetation appeared to change. Samphires were identified in the field where possible and small vegetative samples were taken for later identification if needed (targeting material with seeds or flowers).

Thirteen other smaller lakes and wetlands were visited to compare Tecticornia species with those growing on the main lakes and to locate Priority 1 species.

7 Results

Results are provided in the Appendix (section 8). The following information is provided:

- Preliminary mapping of Tecticornia at Ten Mile Lake and Lake Sunshine, extrapolating from transect information only.
- Preliminary mapping of known Priority1 Tecticornia species, using information from sites visited both by *actís* and Phoenix (see DBCA Comments)
- Map documenting "the traverses for targeted conservation significant species surveys or further information" (see DBCA Comments)
- Estimates of some Priority 1 populations in areas away from the potential abstraction impacts
- Tecticornia locations that may be targeted for further studies in the future
- Vegetation monitoring suggestions
- Some soil information from beneath selected Tecticornia species.

8 Discussion and Recommendations

8.1 Sampling

The samphire communities at Ten Mile Lake, Lake Sunshine and the two concentrator lakes are the units most affected by the proposed mining operations. The two main potential impacts from the Kalium operations will be direct clearing and potential dewatering drawdown from surface trenches (indirect impact). Considering the fact that samphires (and to a lesser extent the *Melaleuca* belt) are the majority of vegetation affected by the drawdown from mining it would be logical to expect most vegetation sampling to take place in these areas. While the project areas did have sampling from samphire communities, (and at the time of sampling it was probably thought adequate as drawdown contours were not known), because of sterile material and uncertain identification the samphire sampling was not as comprehensive as it could have been.

Samphires fall into two groups – those that hold onto their seeds and those that drop their seed heads once ripe. Samphires are almost impossible to identify without seeds or flowers. To complete a successful vegetation sampling of these species they need to be sampled with ripe seed, which may entail site visits at different seasons.

To ensure that the samphire associations seen at Ten Mile Lake and Lake Sunshine are present at other locations in the region would require sampling of samphire associations away from the project areas. If the same samphire species and associations were found in areas away from mining influences, it would be safe to assume that they would replace those potentially lost from the mining areas.

It has been found by *actís* and reported in various publications (Datson 2002a, Datson 2002b, Purvis et al. 2009) that samphire assemblages change radically across the dune or fringe profile, soil type and groundwater composition. It has been found that the standard sampling technique inadequately describes the changes in communities and may overlook some assemblages or species. *actís* favours a 3m by 3m succession of quadrats from playa edge to terrestrial vegetation assemblages for permanent transects (a Belt Transect).

Further sampling is recommended at the lakes in the study area – the *actís* survey was conducted over two days and some sites got only a cursory sampling due to time constraints, though these sites had a thorough sampling by Phoenix previously.

8.2 Monitoring

For samphire monitoring it has been found that numerous quadrats in a transect covering samphire zonation from playa to dunes gives better results, especially if zonation changes over time. 3m by 3m quadrats in a transect that can reach any length have been found to be useful. If samphire vegetation remains the same over a distance the transect can be stopped and resumed when the samphire species change.

At least four transects should be placed in each project indirect impact area with at least four transects at other places around the lake (depending on access) where the vegetation is similar. Sites where monitoring is considered important are listed on pages 20 to 22.

It is suggested that estimates of density (% coverage), diversity and health be included in the monitoring areas.

Photographic records have been found to be useful – photographs should be taken at each transect with a dated and site-numbered board in sight. If a transect is particularly long multiple photographs can be taken.

It is suggested that at the beginning of operations the transects are visited twice a year to ascertain the plant health and any changes in vegetation that may occur, either natural or as a result of the mining operations.

If the vegetation remains unchanged over time (to be specified) this could be reduced to annual site visits. The annual monitoring should be for the life of the project.

8.3 Dewatering Drawdown

To monitor drawdown, it is recommended to place nested piezometers in the drawdown areas and outside the drawdown zone.

8.4 Revegetation

Post mining the samphire community will re-establish in the disturbed areas. They may not have the same zonation as pre-operations and perhaps drainage will be different. Over time the groundwater level will stabilise in the area though may always be different to pre-mine levels. When clearing the site, topsoil, especially the top 20cm, should be stored carefully in windrows of not more than 2m high to be used for revegetation.

The sodium chloride salt stockpile is expected to finally cover an area of up to 150ha and be up to 15m high. The bund around the stockpile will limit dissolution from lake fills and would limit the amount of salt across the lake/s. The salt in the stockpile will also contain gypsum which will help to stabilise the stockpile and create impervious layers (see *actís* memo 'Salt Stockpile on Ten Mile Lake' 18.09.2018). At least two monitoring transects should be placed adjacent to the stockpile to evaluate potential changes to the samphire population.

8.5 In Answer to General EPA Concerns/Queries

1. Do you think the majority of Tecticornia species have now been recorded, or would you expect further surveys to identify many other species? I think there is a high probability that the majority of species has been identified, especially on the two main lakes and the concentrator lakes. There are some areas that warrant further surveys which are mentioned in the *actís* report, but it is unlikely that more species will be found in the main areas to be potentially affected. To further confirm this assumption, one more study would be warranted at Lake Sunshine (to double check) plus the two vegetated lakes #1 and #2.
2. Is the area prospective for the discovery of new Tecticornia species? Or have results been as expected? The Phoenix surveys found samphire species at some sites which were 'new' species, however they were part of an extensive community of 'common' species, sometimes in pure stands, sometimes mixed with others. Ephemeral paleo lakes often have 'new' species when first surveyed because they have been isolated from other wetlands by distance and desert, so in that way the results were not unexpected. It has been found that sometimes a pocket of 'new' species can be 'hiding' in a location such as deep coves or invaginations, inlet creeks or satellite wetlands. The *actís* site visit covered as many of these as time allowed. The likelihood of finding new Tecticornia species in subsequent surveys is much lower than in the first survey.
3. Did you identify any specific habitats that would result in Tecticornia species only being found in that one location? I.e. do you think any new species could ONLY be found on the concentrator lakes? Or within the drawdown zone (see attached for updated modelling)? All priority listed species were found in locations away from the lakes to be potentially affected. Tecticornia sp. Sunshine Lake is found on the lake playa at the lowest point and next to the bare playa and could be potentially affected by the drawdown but it was also found at the Beyondie Lakes, away from the abstraction zone. We note that the original project plan was to use Beyondie Lakes for production. They have been well surveyed and will not be impacted by the Proposal.
4. Kalium has committed to additional surveys prior to brine abstraction from trenches, can you clarify what additional work would be required based on the updated drawdown impact areas, to meet current EPA guidance? Permanent Belt Transects for monitoring should be installed prior to abstraction to give a baseline study of the vegetation (as per *actís* report recommendations). At this time a further study could take place to cover areas that were not as well covered as I would have liked – Lake Sunshine only had three transects and there were some specimens that may or

may not have been hybrids found there plus Vegetated Lakes #1 and #2 had only one study site each. On Ten Mile Lake at T3 and T4 a samphire was found that could not be identified – it had no seed or flower at the time of the visit. I would be happy to liaise with whoever will be doing the footwork to give locations of further studies.

The EPA's main concern seems to be the chance of a new species only being found within impact areas – what is your opinion on the likelihood of that occurring? As can be seen by the *actís* maps, all priority species have been found on other wetlands/lakes away from the abstraction areas. The chance of a 'new' species being found only within the impact area is highly unlikely, especially when looking at the revised abstraction maps, which appear to have refocussed trenches on bare playa, rather than vegetated samphire flats. If I was to look for 'new' species, I would be inclined to look elsewhere than next to bare playa.

8.6 Summary of Recommendations

Additional Surveys

1. Recommend a further study at Lake Sunshine as it only had three transects and there were some specimens that may or may not have been hybrids found there. Some samples were taken of plants with indeterminate identification - *T. aff pruinosa/auriculata* at S1 and S2.
2. Recommend a further survey at Vegetated Lakes #1 and #2 as they had only one study site each, and Vegetated Lake #1 had a possible *T. laevigata/pruinosa* hybrid or maybe 'new' species.
3. Ten Mile Lake T3 and T4 had samphires *Tecticornia* NOID, which were distinctly different from others but were sterile – must flower/seed at a different time. Surveys should also be undertaken in summer to autumn – March to June – depending on weather as most rain in this region falls in summer.

Monitoring

1. **Ten Mile Lake -** Six sites are recommended on this lake for monitoring transects – at T1, T2, T2A, T3, T4 and T5. With the revised extraction plan, one or more of these transects may serve as a control.
2. **Ten Mile Concentrator Lake** - there should be a monitoring transect at this lake.
3. **Lake Sunshine** - five monitoring transects are recommended on this lake – at S1, S2 and S3 plus two transects on the north shore - one to the north east, the other to the north west between the shore and an island. As at Ten Mile Lake one or more of these transects may be used as a control.
4. **North Lake Sunshine** - should have one monitoring transect at the western end.
5. **Vegetated Lakes #1 and #2, Sunshine Concentrator Lake** - there should be one monitoring transect at each of these lakes.

Other Recommendations

Windrows of topsoil

Nested piezometers for groundwater monitoring

9 Appendix

9.1 Extent of P1 populations

9.1.1 Ten Mile Lake

Ten Mile Lake is a large ephemeral playa lake of about 4526.88 ha. Kalium has a mining lease over roughly half of the lake – the eastern portion. This side of the lake has extensive samphire flats as can be seen in Figure 121, with bare playa being a lesser portion of the lake bed. It has been proposed that the salt stockpile be placed in the bare portion of lake bed to the north of the lake where there is no vegetation.

Transect T1 was placed from side to side (about 160m) across a vegetated invagination – this was slightly higher in the lake profile with vegetation reflecting that found in the 'mid zone' of samphire flats with both *Tecticornia willisii* P1 and *T.* Christmas Creek P1 common in the mixed *T. indica* subsp. *bidens*/ *T. indica* subsp. *leiostachya* community. It is not expected that this transect will be influenced directly by project operations, however **this would be a good site for a monitoring transect to be set up.**

Transect T2 was situated on the lake playa beside a peninsula, again on an extensive samphire flat on the lake playa. The transect measured about 110m from bare playa to the old grey playa sediment 3m cliff at the lake edge. The samphire vegetation was zoned according to the lake height profile (very small differences in height) with *T.* sp. Sunshine Lake P1 common at the edge of the bare playa at the lowest point (about 50m band) mixed with *T. peltata* and *T. willisii* P1. From then on to the 'cliff' was a mixed community of T. *indica* subsp. *bidens/leiostachya* mixed with *T. willisii* P1 and *T.* sp. Denny's Crossing. There will potentially be a brine collection trench adjacent to this site and **this would be a good site for a monitoring transect**.

T2A was situated further north along the same peninsula as T2 where spot checks found a moderate population of *T.* sp. Christmas Creek P1 in a mixed *T. peltata, T.* sp. Christmas Creek P1 community. This site will also potentially be adjacent to a brine collection trench and could **have some monitoring**.

Transect T3 was situated at the south eastern end of Ten Mile Lake and crossed a broad invagination from side to side, a distance of about 415m. As seen in T1 this part of the lake is slightly higher in the lake profile and is totally vegetated with an extensive and healthy samphire community with some zonation (see Figure 28) according to slight variations in ground height. *Tecticornia laevigata* appeared to be common in a (slightly) wetter zone, while *T. willisii* P1 was common in a community with *T. indica* subsp. *bidens/leiostachya* and *T.* sp. Denny's Crossing. There will potentially be a brine collection trench in this area, so **this would be a good site for a monitoring transect**.

Transect T4 was situated near the tenement boundary on the mid southern shore of the lake, again on an extensive lake playa samphire flat and measured about 400m. The samphire community here was homogenous, with a mixture of *T. peltata*, *T. undulata*, *T. indica* subsp. *bidens* and *T. willisii* P1 for the first 170m from the bare playa, then *T. undulata*, *T. indica* subsp. *bidens* and *T. willisii* P1 for the remainder up to the calcrete dune at the edge of the lake. There will potentially be a brine collection trench adjacent to this area, so **this would be a good site for a monitoring transect**.

Transect T5 was situated at the northern end of the Lake, near the base camp and on a vegetated broad invagination of the lake playa. It measured about 350m and began at the lowest point which was vegetated with *Tecticornia* sp. Sunshine Lake P1 and *T. peltata.* Further along the transect and on slightly higher elevation the samphire community changed to *T. willisii* P1 and *T. indica* subsp. *bidens*. Spot checks of a slightly higher elevation to the north of this site revealed a community of *T. willisii* P1, *T. indica* subsp. *bidens* and *T. globulifera* P1, with Melaleuca trees at the edge of the red dune. There will potentially be a brine collection trench in this area, so **this would be a good site for a monitoring transect**.

9.1.2 Lake Sunshine

Lake Sunshine is a large ephemeral lake of about 2944.97 ha to the north east of Ten Mile Lake. Unlike Ten Mile Lake, Lake Sunshine has a playa that is cream-coloured kopi (gypsum) has several vegetated islands and has much less vegetation on the playa. Kalium proposes to put in trenches along the lake and several bores, for the extraction of lake brine.

Transect S1 was situated at the western end of Lake Sunshine where there is vegetation on the playa. Due to time constraints the helicopter was used to spot changes in vegetation along the transect and sampling carried out accordingly. The samphire community here was mixed with no Priority species collected. There is a proposed extraction bore and a trench pump adjacent to this location, which could be **a good site for a monitoring transect**.

Transect T2 was situated on the southern side of Lake Sunshine in a broad vegetated cove and was about 300m in length. The transect ran between a low point on the lake playa to the red dune at the side of the lake. The samphire community at the lowest point consisted of *Tecticornia* sp. Sunshine Lake P1 (see Figure 7) and *T. auriculata,* which changed to *T. pruinosa, T. auriculata* and *T.* Denny's Crossing higher in the profile. A proposed trench pump may be adjacent to this site which could be **a good site for a monitoring transect**.

Transect T3 was situated at the north eastern end of Lake Sunshine where there are extensive samphire flats. The transect measured about 300m and again, the helicopter was used to spot changes in vegetation along the transect and sampling carried out accordingly. The majority of the samphire community here consisted of *Tecticornia* sp. Denny's Crossing and *T. willisii* P1 (see Figure 6). Further study at this site is needed and as there may be a brine collection trench proposed for this area this could be **a good site for a monitoring transect**.

9.1.3 North Sunshine Lake

North Sunshine Lake is a small ephemeral lake of about 1193.64 ha to the north east of Lake Sunshine but not continuous with it. It is kopi with red sand dune mixed to give the soil a pink-ish hue. Much of the western end of the playa is vegetated with the eastern end having more bare playa and several islands. Spot checks revealed an extensive population of *Tecticornia bibenda* P1 (see Figure 3), especially at the foot of dunes both at the lake shore and on islands in the lake. There were none on the playa itself. Other samphires in the community were *T. auriculata, T. calyptrata, T. laevigata, T. indica* subsp. *leiostachya* and *T.* sp. Denny's Crossing.

9.1.4 T Junction Lake

T Junction Lake is a small ephemeral vegetated lake of about 465.73 ha to the north east of Sunshine and North Sunshine Lakes and also South T Junction Lake. The playa is red friable sediments and the samphire communities are quite delineated with an extensive population of *Tecticornia bibenda* P1 (see Figure 3) in the lower portion of the lake profile in a community that also consisted of T. auriculata, T. indica subsp. bidens, T, laevigata and T. sp. Denny's Crossing. This lake was flown around in the helicopter to ascertain the extent of the T. bibenda P1 population and apart from the extensive population in the centre of the lake, it was also very common at the foot of the red dunes at the side of the lake.

9.1.5 South T Junction Lake

South T Junction Lake is a small ephemeral lake of about 393.8 ha to the south west of T Junction Lake and to the north east of North Sunshine Lake. There were many Casuarina trees on the playa of this lake and the mixed samphire community consisted of *Tecticornia pterygosperma* subsp. *denticulata, T. indica* subsp. *bidens, T.* sp. Denny's Crossing, *T. calyptrata, T. laevigata* and *T. indica* subsp. *leiostachya*, none of which carries a Priority status.

9.1.6 Vegetated Lakes #1 and #2

These two lakes are to the west of Lake Sunshine but not continuous with it and were extensively studied by Phoenix who collected *Tecticornia willisii* P1 (see Figure 6) in their survey. There were no priority samphire species collected by *actís* at these two sites, though the photographs taken indicate the presence of *T. willisii* P1. Species collected in the samphire community were *Tecticornia* sp. Denny's Crossing, *T. laevigata*, *T. indica* subsp. *bidens* and *T. calyptrata*.

9.1.7 Sunshine Concentrator Lake

This small lake is to the south west of the two Vegetated Lakes and is potentially earmarked to be used as a concentrator pond for brine. It has a largely vegetated playa with a predominance of *Tecticornia laevigata*, *T. indica* subsp. *bidens*, *T.* sp. Denny's Crossing, *T. calyptrata* and *T.* sp. Christmas Creek P1 (see Figure 5). Phoenix carried out a much more extensive survey of this lake and found *T. willisii* P1 also but *actís* did not collect it.

9.1.8 Beyondie #1

The Beyondie Lakes #1 and #2 are north of Ten Mile Lake and joined to it by a channel and joined to each other also by a natural channel. The two lakes total about 966.85 ha. Extensive surveys were done of the Beyondie lakes by Phoenix – *actís* carried out one transect on each lake as the decision had been made that the Beyondie Lakes would not be included in the Kalium project zone.

Beyondie Lake #1 has a mostly bare playa with some samphire vegetation around the edge of the lake. The transect was about 300m long and covered a vegetated part of the northern shore of the lake and included a slightly lower-lying 'sump'. The samphire community included *Tecticornia globulifera* P1 (see Figure 4, common in the upper zone), *T.* sp. Denny's Crossing, *T. indica* subsp. *bidens*, and *T. peltata* and with *T.* sp. Sunshine Lake P1 (see Figure 7) in the lowest zone.

9.1.9 Beyondie #2

Beyondie Lake #2 also had a large amount of bare playa but also had three long arms to the west with vegetated playas. The transect was situated on the western shore of the bare playa and was about 200m long. On the bare playa many *Tecticornia pergranulata* juveniles had germinated after rain and now were dying off. In the slightly lower portion of the lake profile was a samphire community consisting of *Tecticornia* sp. Christmas Creek P1 (see Figure 5), *T.* sp. Denny's Crossing, and *T. globulifera* P1 (see Figure 4). Further away and higher in the profile the community changed to *T. indica* subsp. *bidens*, *T.* sp. Denny's Crossing and *T.* sp. Christmas Creek P1. Phoenix collected *T. willisii* P1 also, during their extensive survey.

9.1.10 Yanerri Lake

Yanerri Lake is a small lake to the north of Ten Mile Lake – the main playa is about 732.23 ha and the smaller wetland to the east of it is about 54.03 ha. Two sites were visited at Yanerri Lake, one on the main playa and the other in the smaller wetland. The main playa was open kopi with extensive samphire flats featuring *Tecticornia* sp. Denny's Crossing, *T. willisii* P1 (see Figure 6), *T. indica* subsp. *bidens* and *T.* Christmas Creek P1 (see Figure 5). The long wetland which was separated from the main lake by a dune featured a population of *Tecticornia bibenda* P1 (see Figure 3), which was also seen along the main inlet river, Ligaran Creek.

9.1.11 Terminal Lake

Terminal Lake (1748.03 ha) is to the east of Yanerri Lake and connected to it by a shallow channel – as the name suggests it is the end lake of a series. The playa is largely vegetated and has Casuarina trees growing out onto the playa. *actís* did not sample this lake but low flying around the lake in the helicopter was adequate to see the substantial population of *Tecticornia bibenda* P1 (see Figure 3) at the edge of this lake.

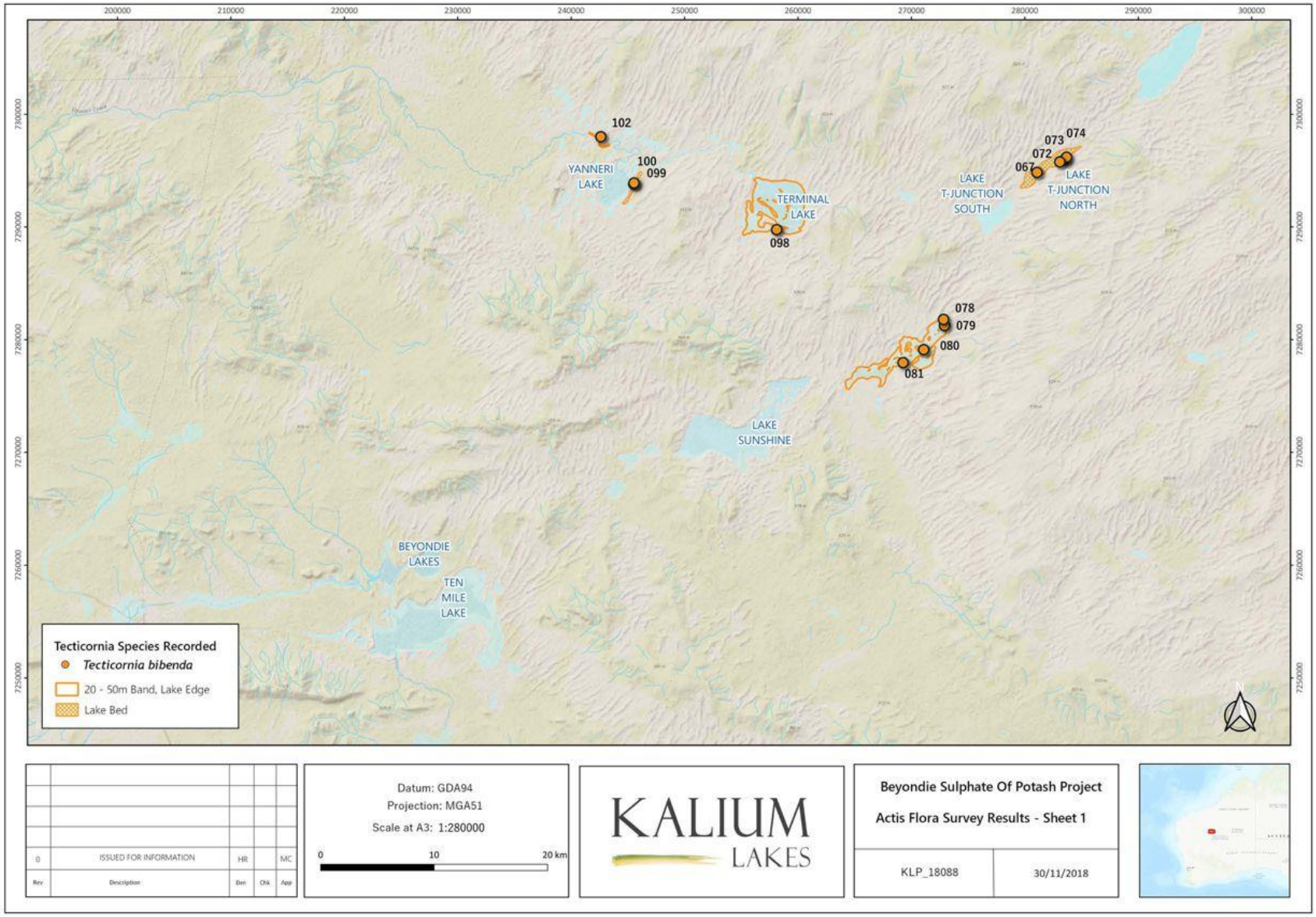

Figure 3 - *Tecticornia bibenda* distribution (*actís* survey records)

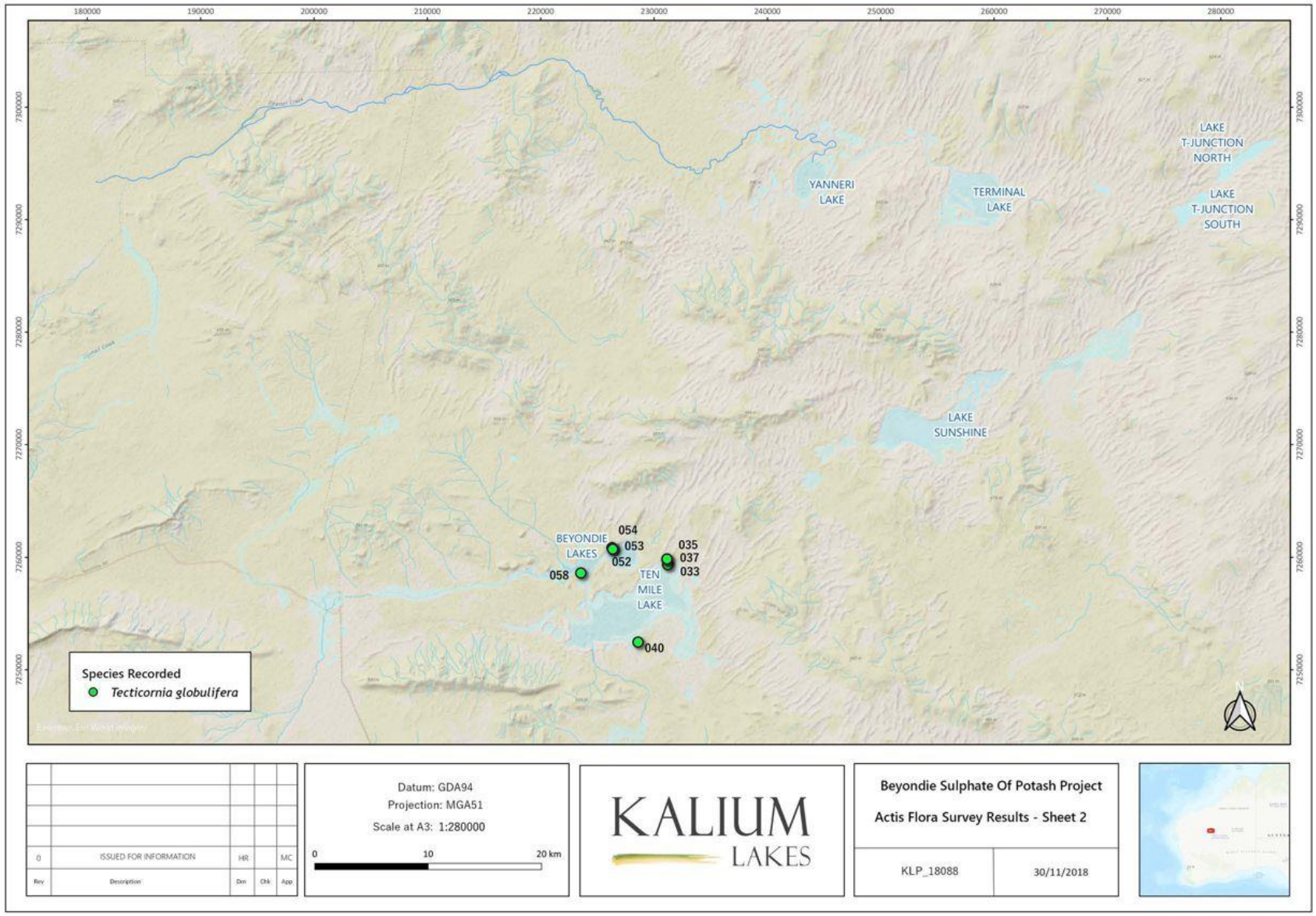

Figure 4 - *Tecticornia globulifera* distribution (*actís* survey records)

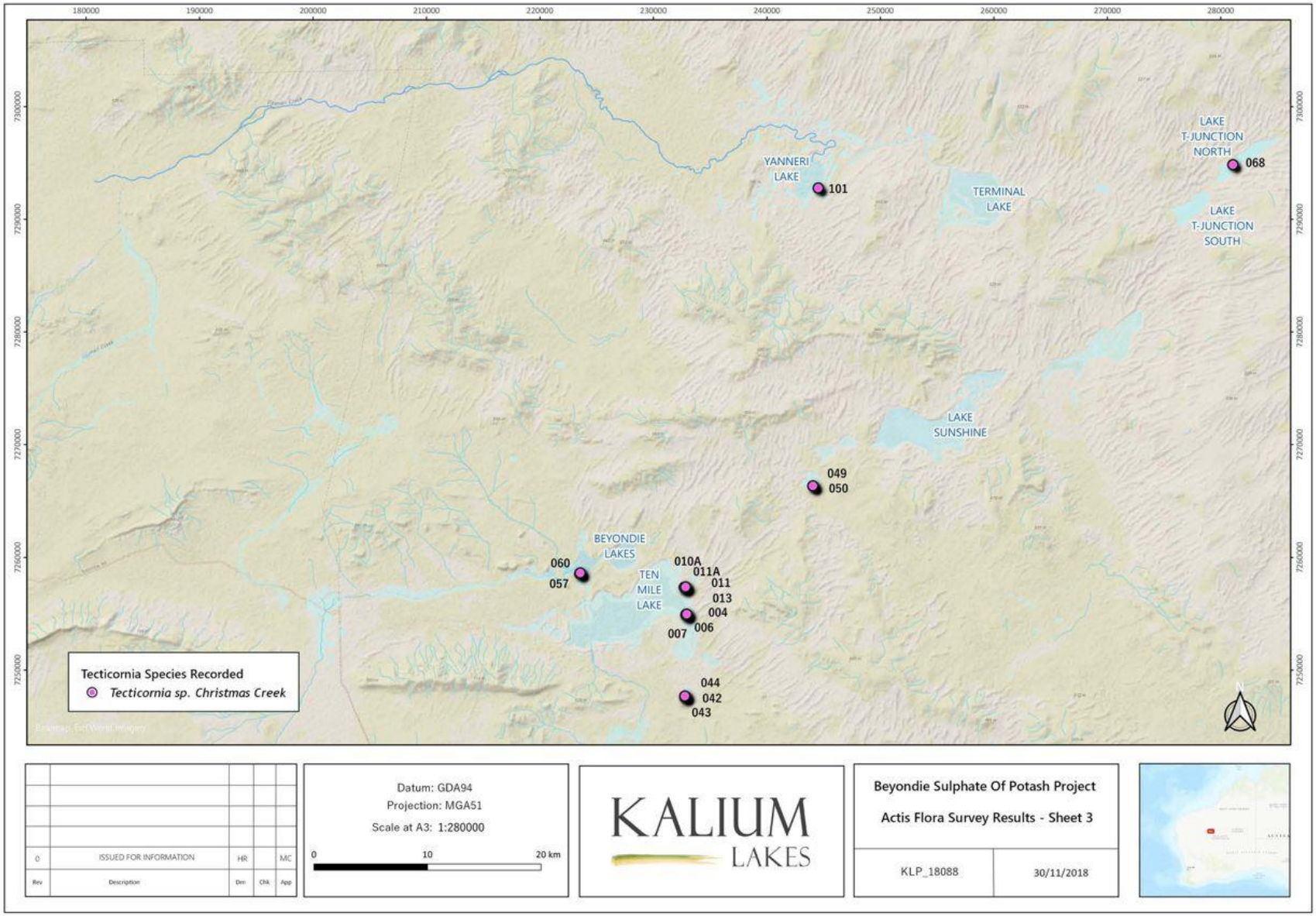

Figure 5 - *Tecticornia* sp. Christmas Creek distribution (*actís* survey records)

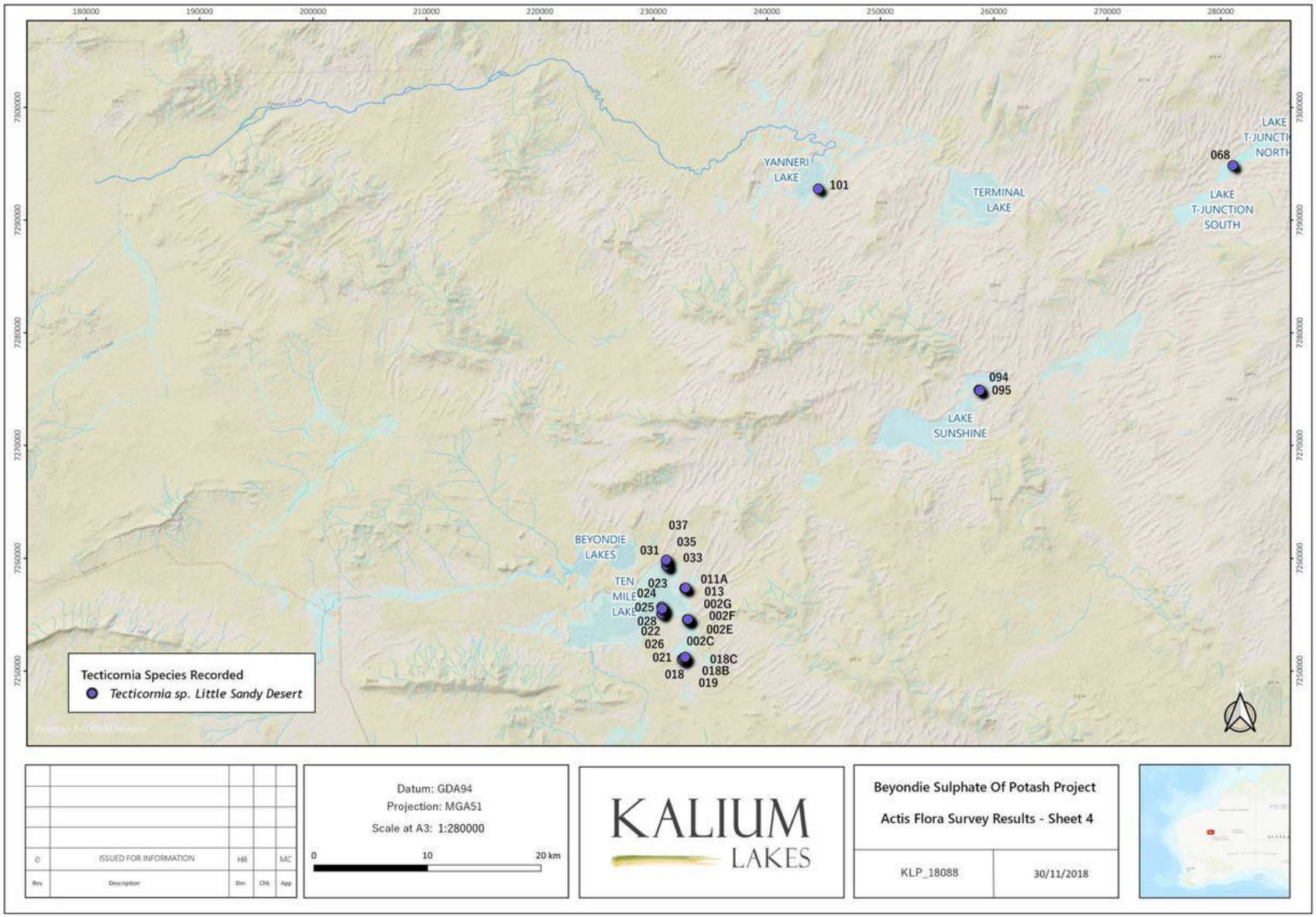

Figure 6 - *Tecticornia willisii* distribution (*actís* survey records)

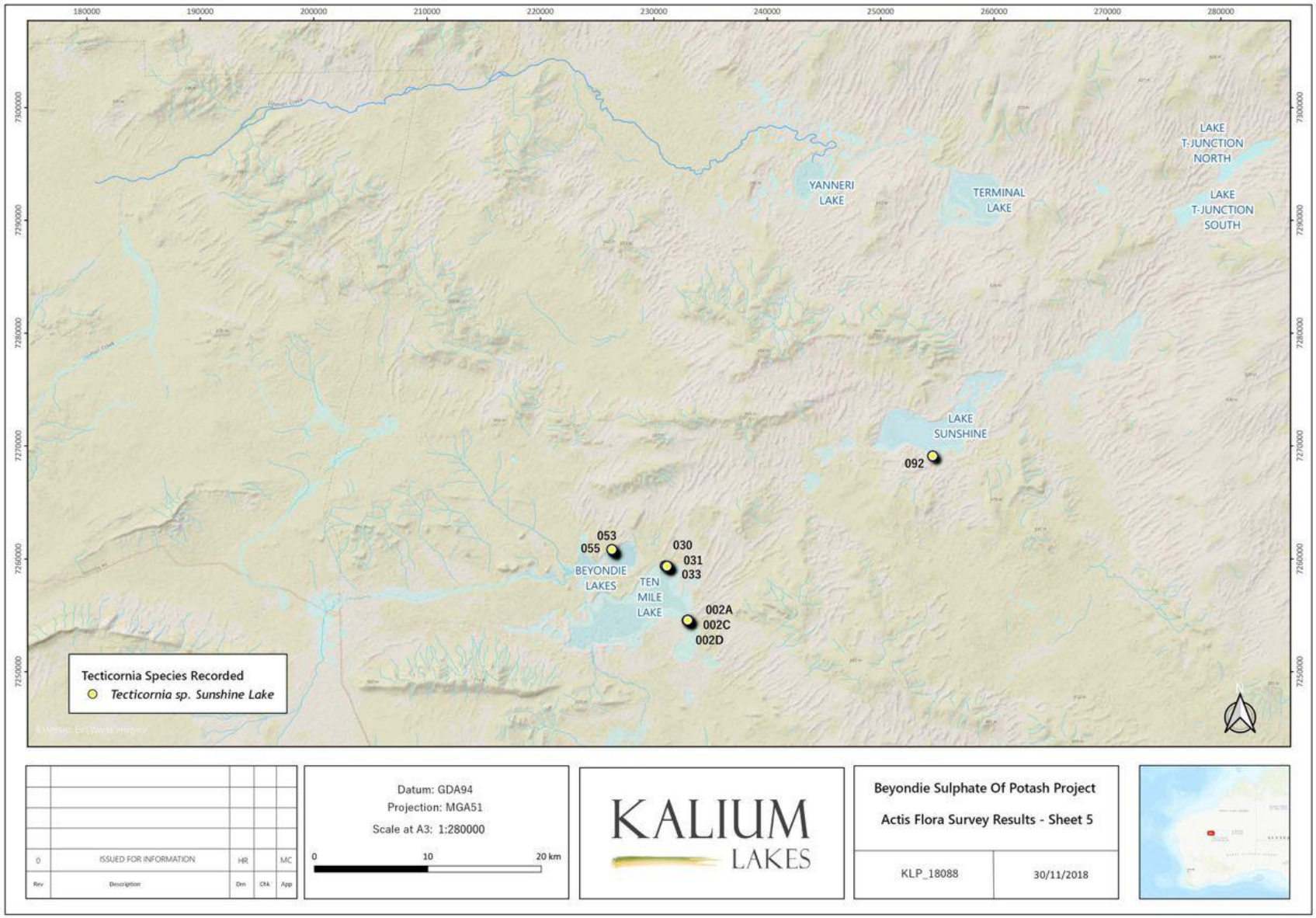

Figure 7 - *Tecticornia* sp. Sunshine Lake distribution (*actís* survey records)

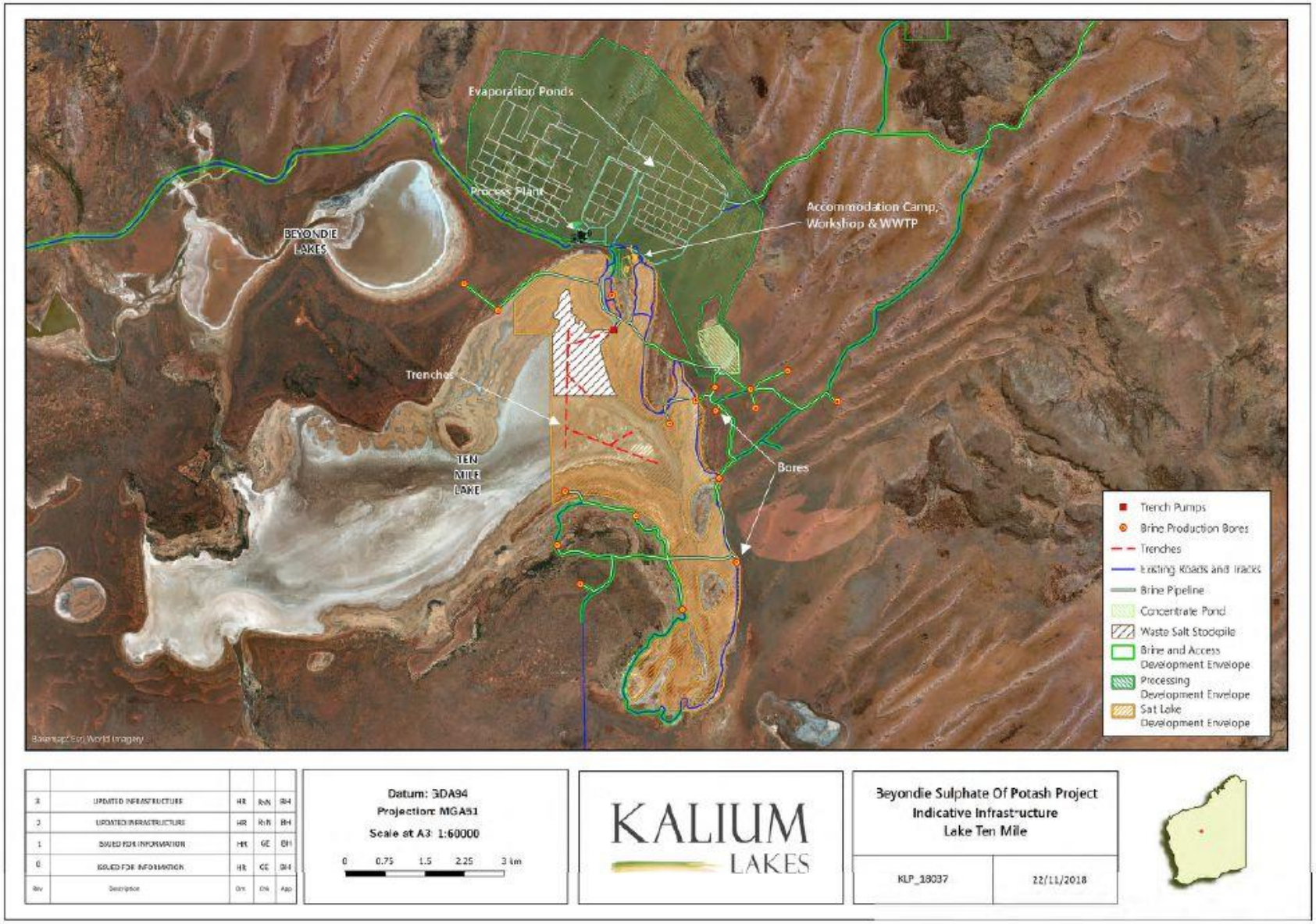

Figure 8 - Kalium Indicative Infrastructure, Ten Mile Lake

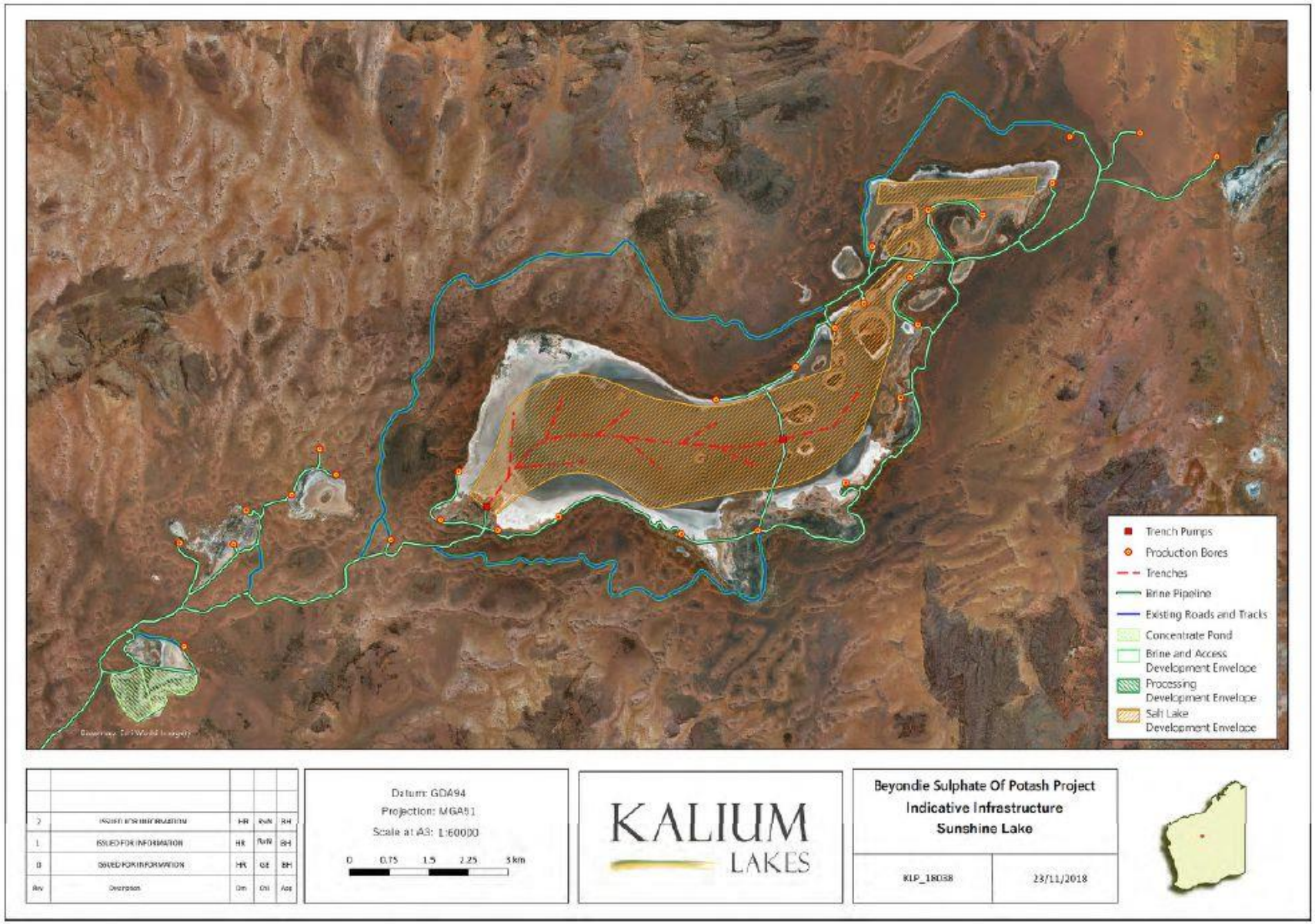

Figure 9 - Kalium Indicative Infrastructure, Lake Sunshine

9.2 Soil Sampling

During the course of visiting the lakes for samphire identification, soil samples were taken from the root zones of selected plants to ascertain the salt load. The soil was tested for moisture content, pH, salt in soil in grams per kilogram salinity of moisture, results below. The soil sample from WP17 was from beneath a *Tecticornia laevigata* at T3, Ten Mile Lake. WP18 was from beneath *Tecticornia indica* subsp. *bidens* and *T. willisii* at T3 Ten Mile Lake, WP33 was from *T. indica* subsp. *bidens*, *T. willisii* and *T.* sp. Denny's Crossing at T5, Ten Mile Lake. WP67 was from beneath *Tecticornia bibenda* at T Junction Lake, WP9 was from beneath *Tecticornia laevigata* T2 Ten Mile Lake, WP80a and WP80b were from beneath *Tecticornia bibenda* on North Sunshine Lake and WP47 was from beneath *Tecticornia laevigata* and *T.* sp. Denny's Crossing on Ten Mile South Lake.

Table 1 - Soil sampling beneath samphires

WP	**17**	**33**	**67**	**18**	**9**	**80 a**	**47**	**80 b**
% Moisture	1%	1%	11%	10%	5%	6%	15%	3%
pH	9.25	8.75	9.75	8.75	9.75	8.75	8.75	8.75
Salt in soil g/Kg	4.95	8.34	81.69	119.28	39.14	20.17	165.54	32.59

Table 2 – Soil sampling per species

Species	**% Moisture**	**Salt in soil g/Kg**	**pH**
Tecticornia laevigata	1%, 5%, 15%	4.95, 39.14, 165.54	8.75, 9.25, 9.75
T. Indica subsp. *bidens*	1%, 10%	8.34 - 119.28	8.75
T. willisii	1%, 10%	8.34 - 119.28	8.75
T. sp. Denny's Crossing	1%	8.34 - 119.28	8.75
Tecticornia bibenda	3%, 5%, 11%	20.17, 32.59, 81.69	8.75, 9.75

The soil beneath *Tecticornia laevigata* showed the most variability in both moisture and salt content, with soil beneath *T. indica* subsp. *bidens* and *T. willisii* with less variability and the soil beneath *Tecticornia bibenda* with the least variability. These results are limited by the number of samples taken, which have only given an indication of conditions these plants are growing in.

9.3 Site Descriptions

9.3.1 Ten Mile Lake

9.3.1.1 Ten Mile Lake, T1

Figure 10 - Ten Mile Lake near T1 – invagination centre right, transect from side to side

Figure 11 - Ten Mile Lake approaching T1, wetland WP14 and WP15 centre rear (star)

Figure 12 - Ten Mile Lake T1 looking from dune across vegetated playa to dune on other side

This Ten Mile Lake site, T1 (Figure 121), was across an invagination of the lake on the Eastern side. The playa was vegetated by samphires, among them the Priority 1 *Tecticornia* sp. Christmas Creek. Vegetation was all healthy with many species featuring mature seed heads and some with flowers. The site was bounded on both sides by red sand dunes and the (vegetated) playa was reddish sand and Kopi mixed. A transect of about 160m was walked and *Tecticornia* spps. noted at intervals (see Table 3 and Table 4). Samples were taken of vegetation where necessary. There were two tracks bisecting this transect.

Priority Species at this site:
Tecticornia sp. Christmas Creek (K.A. Shepherd et al. KS 1063) (P1 WC Act)
T. willisii P1

Figure 13 - Ten Mile Lake near T1, red wetland vegetation, *Tecticornia* indica subsp. *bidens* in foreground

Small Wetland

Across the red dune from T1 transect was a small wetland (WP14 and WP15) with red sandy soil and firm biofilm. The vegetation was mostly terrestrial but featured *Frankenia* sp. and some *Tecticornia indica* subsp. *bidens* and some *T*. sp. Denny's Crossing (see Table 4).

There were no Priority 1 Tecticornia species here.

9.3.1.2 Ten Mile Lake T2

Figure 14 - Ten Mile Lake T2, WP2, looking from bare playa to calcareous cliff

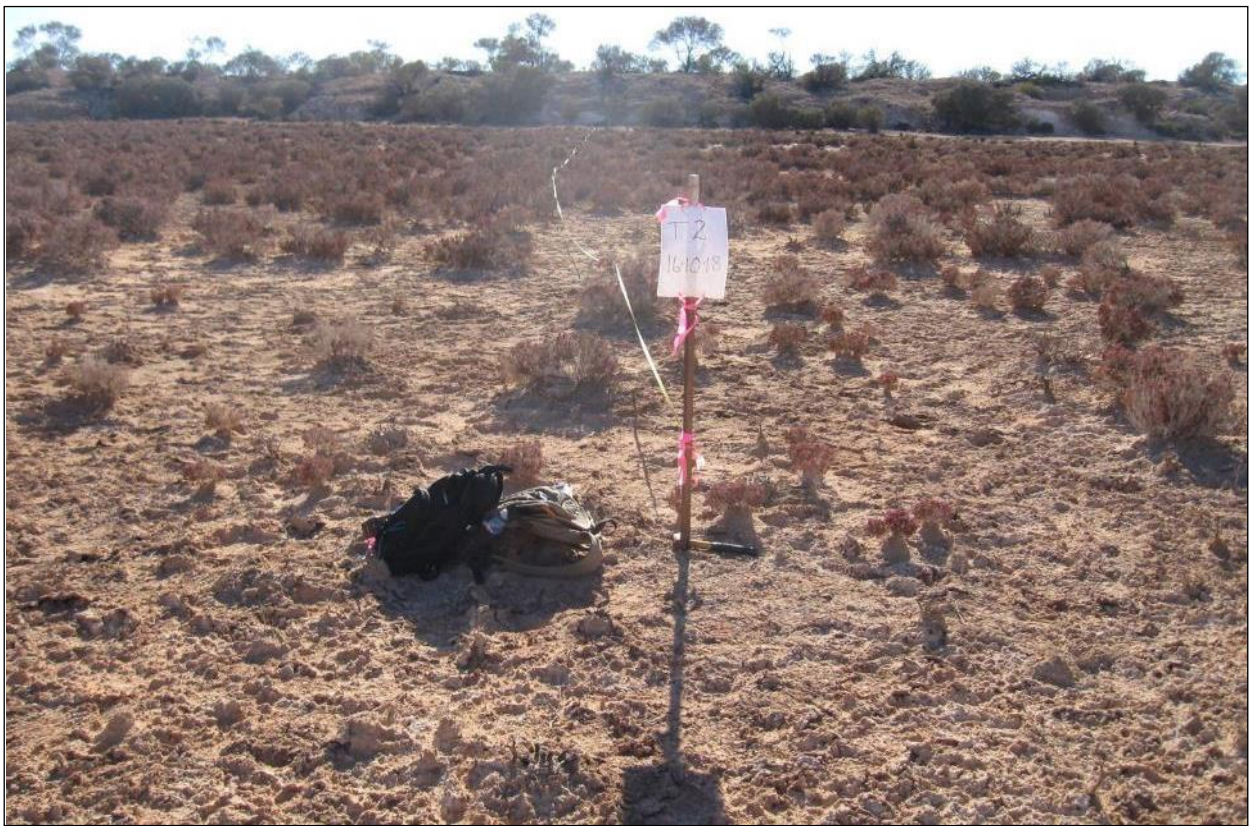

Figure 15 - Ten Mile Lake T2, WP2

This site was on the vegetated playa beside a peninsular that juts out into the Lake (see Figure 121). The soil was dry, lumpy and crusty kopi (gypsum) and the 3m cliff at the edge of the vegetated playa appeared to be ancient calcareous sediments.

Priority Species found at this site:
T. willisii P1
T. sp. Sunshine Lake (K.A. Shepherd et al. KS 867) P1

9.3.1.3 Ten Mile Lake between T2 and T2A

Figure 16 - Ten Mile Lake T2A *Tecticornia* indica subsp. *bidens*

Figure 17 - Ten Mile Lake T2A, *Tecticornia peltata* flowering and seeding

Figure 18 - Ten Mile Lake T2A, *Tecticornia peltata* flowering

Figure 19 - Ten Mile Lake T2A, *Tecticornia peltata* seeding

Figure 20 - Ten Mile Lake T2A, *Tecticornia peltata* seeding

Figure 21 - Ten Mile Lake T2A, *Tecticornia undulata* seeding

Figure 22 - Ten Mile Lake T2A, WP9 Road beside calcareous cliff at edge of transect

This site was on the vegetated playa beside the peninsular, some distance along the 'beach' from T2 (see Figure 121). As at T2, the soil was dry, lumpy and crusty kopi (gypsum) and the 3m cliff at the edge of the vegetated playa appeared to be ancient calcareous sediments.

Priority Species found at this site:
Tecticornia sp. Christmas Creek (K.A. Shepherd et al. KS 1063) (P1 WC Act)

9.3.1.4 Ten Mile Lake T3

Figure 23 - Ten Mile Lake approaching T3, note vegetated playa

Figure 24 - Ten Mile Lake approaching T3

Figure 25 - Ten Mile Lake T3 coming in to land

Figure 26 - Ten Mile Lake T3 transect

Figure 27 - Ten Mile Lake T3, WP16, *Tecticornia laevigata* flowering

Figure 28 - Ten Mile Lake T3, WP18 soil sampling, note vegetation zonation coloration green (*T. laevigata)* to red (*T.* Denny's Crossing, *T. willisii* and *T. indica* subsp. *bidens*)

Figure 29 - Ten Mile Lake T3, 178m, mixed *Tecticornia* – T. *indica* subsp. *bidens* and *T. willisii*

Figure 30 - Ten Mile Lake T3, 178m *Tecticornia indica* subsp. *bidens* (denticulate)

Figure 31 - Ten Mile Lake T3, WP19, extensive *T. willisii* belt

This site was in the south eastern corner of Ten Mile Lake, in a wet invagination of the lake (see Figure 121). The soil was reddish beige with a strong biofilm. Tecticornia species were zoned according to playa height and also soil type, as can be seen in the aerial photograph (Figure 25). The transect stretched from side to side of the invagination, about 400m. *Melaleuca* sp. trees were growing at the foot of the dunes at the lake edge – indicating fresh water runoff from dunes.

Priority species found at this site:
Tecticornia willisii P1

9.3.1.5 Ten Mile Lake T4

Figure 32 - Lake playa between T3 and T4, test trenches

Figure 33 - Lake edge between T3 and T4 - note extensive samphire flat on playa

Figure 34 - Lake playa opposite T4

Figure 35 - Brine extraction bore, opposite T4 and near tenement boundary

Figure 36 - Ten Mile Lake T4, edge of bare playa, *Tecticornia peltata*

Figure 37 - Ten Mile Lake T4, zonation change from *Tecticornia laevigata* to *T. willisii*

Figure 38 - Ten Mile Lake T4, *T. laevigata* with *T. willisii* in background

This site was situated near Kalium's tenement boundary and extraction bore (see Figure 121) and was a long samphire flat on the lake playa. The soil at the edge of the bare playa (see Figure 36) was crusty beige/grey kopi (gypsum), closer to the shore (about 150m from the bare playa – see Figure 37) the soil changed, becoming less crusty and lumpy but with a strong biofilm. The dune at the end of the transect was calcrete/gypsum rather than red sand and was fringed by Melaleuca shrubs/trees.

Priority 1 Species found at this site:
Tecticornia willisii P1

9.3.1.6 Ten Mile Lake T5

Figure 39 - Ten Mile Lake between T4 and T5

Figure 40 - Ten Mile Lake between T4 and T5

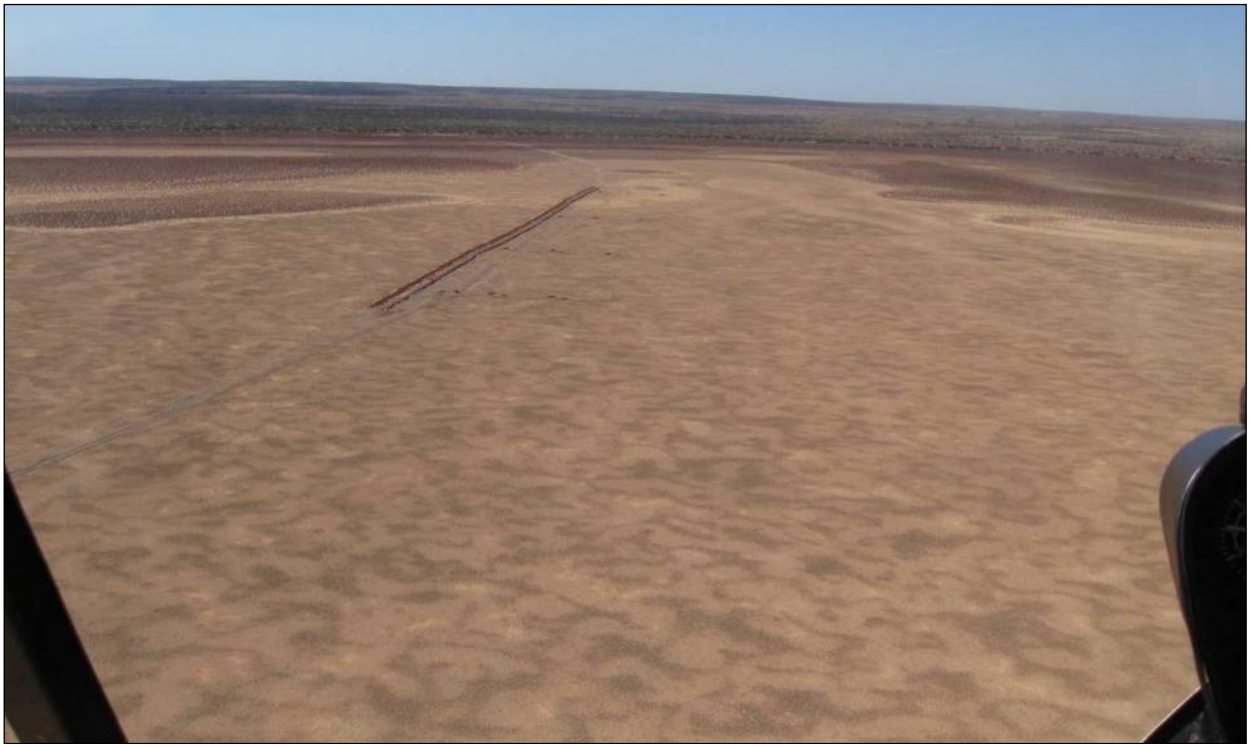

Figure 41 - Ten Mile Lake between T4 and T5, test trench

Figure 42 - Ten Mile Lake approaching T5

Figure 43 - Ten Mile Lake T5, *Tecticornia* sp. Sunshine Lake in foreground, *T. peltata* behind

Figure 44 - Ten Mile Lake T5 towards red dunes, *Tecticornia willisii*

Figure 45 - Ten Mile Lake T5 *Tecticornia* sp. Sunshine Lake

Figure 46 - Ten Mile Lake T5, *Tecticornia indica* subsp. *bidens* (denticulate)

Figure 47 - Ten Mile Lake opposite T5, near red dune WP35, *T. willisii*

Figure 48 - Ten Mile Lake opposite T5, WP37, *Tecticornia globulifera* in band along dunes

This site is within the development area and close to the camp. It is an extensive samphire flat with zonation of species according to playa height and soil type. Areas on either side of this small lake cove were visited at this site (see Figure 121). At the edge of the bare playa (WP30) the samphires were mainly small *Tecticornia* sp. Sunshine Lake (see Figure 45), however species changed with taller *T. peltata* and *T. willisii* (see Figure 47). At T5 the soil was moderately crusty beige Kopi but at the end of the transect the soil was less crusty. There was a hard calcrete dune at the highest profile which was fringed by Melaleuca shrubs. At the site across the cove opposite and to the north of T5, the soil was again crusty Kopi until close to the red sandy dune where it was mixed. The samphire community was *T. willisii* P1, *T. indica* subsp. *bidens* and *T. globulifera* P1 near the dunes which were fringed by Melaleuca sp. shrubs also (see Figure 48).

Priority 1 species at this site:
Teticornia globulifera
T. willisii P1
T. sp. Sunshine Lake (K.A. Shepherd et al. KS 867) P1

9.3.2 Lake Sunshine

9.3.2.1 Lake Sunshine S1

Figure 49 - Approaching Lake Sunshine

Figure 50 - Lake Sunshine showing islands and kopi surface

Figure 51 - Lake Sunshine showing kopi surface

Figure 52 - Lake Sunshine –narrower fringe of samphire flats than Ten Mile Lake

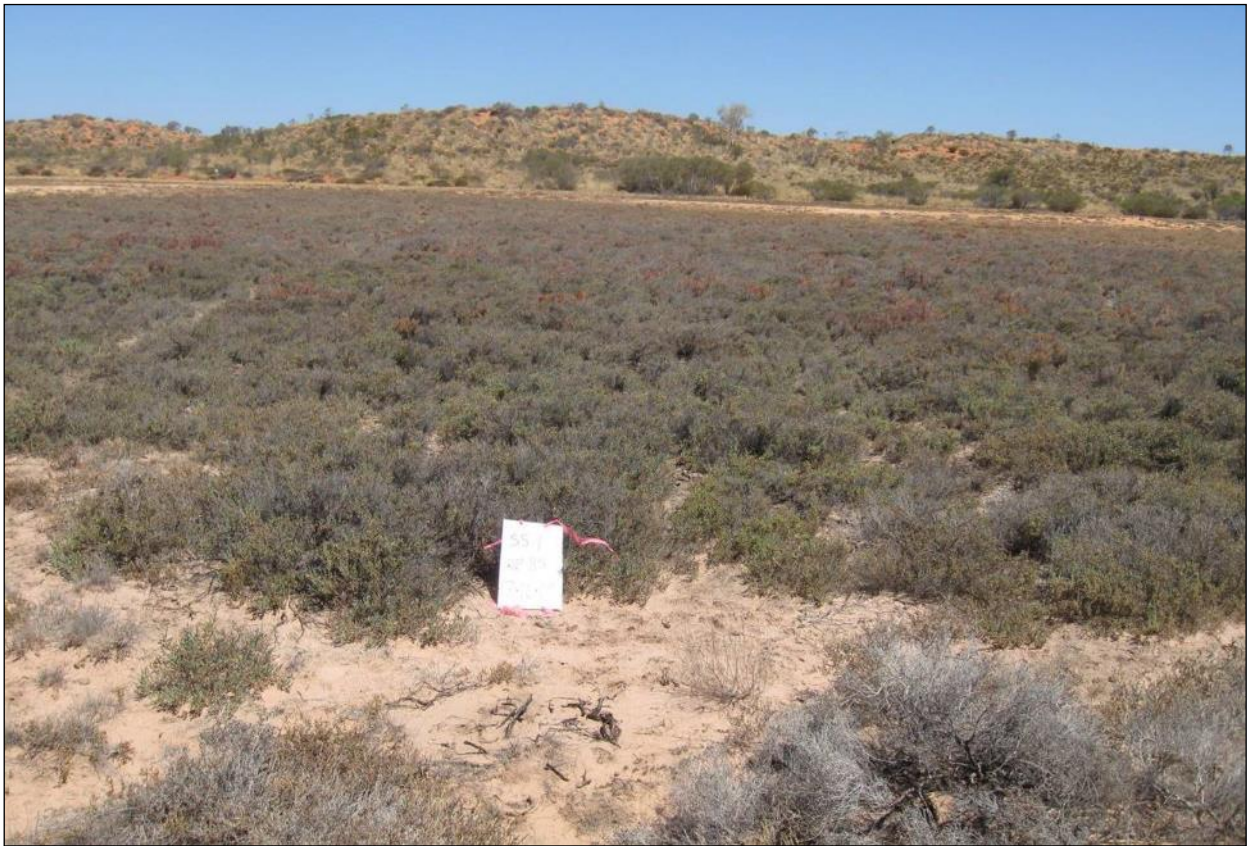

Figure 53 - Lake Sunshine 1, WP85, *Tecticornia laevigata*, *T.* sp. Denny's Crossing and *T. calyptrata*

Figure 54 - Lake Sunshine WP87, *Tecticornia calyptrata*, *T.* aff. *pruinosa*, *T.* sp. Denny's Crossing

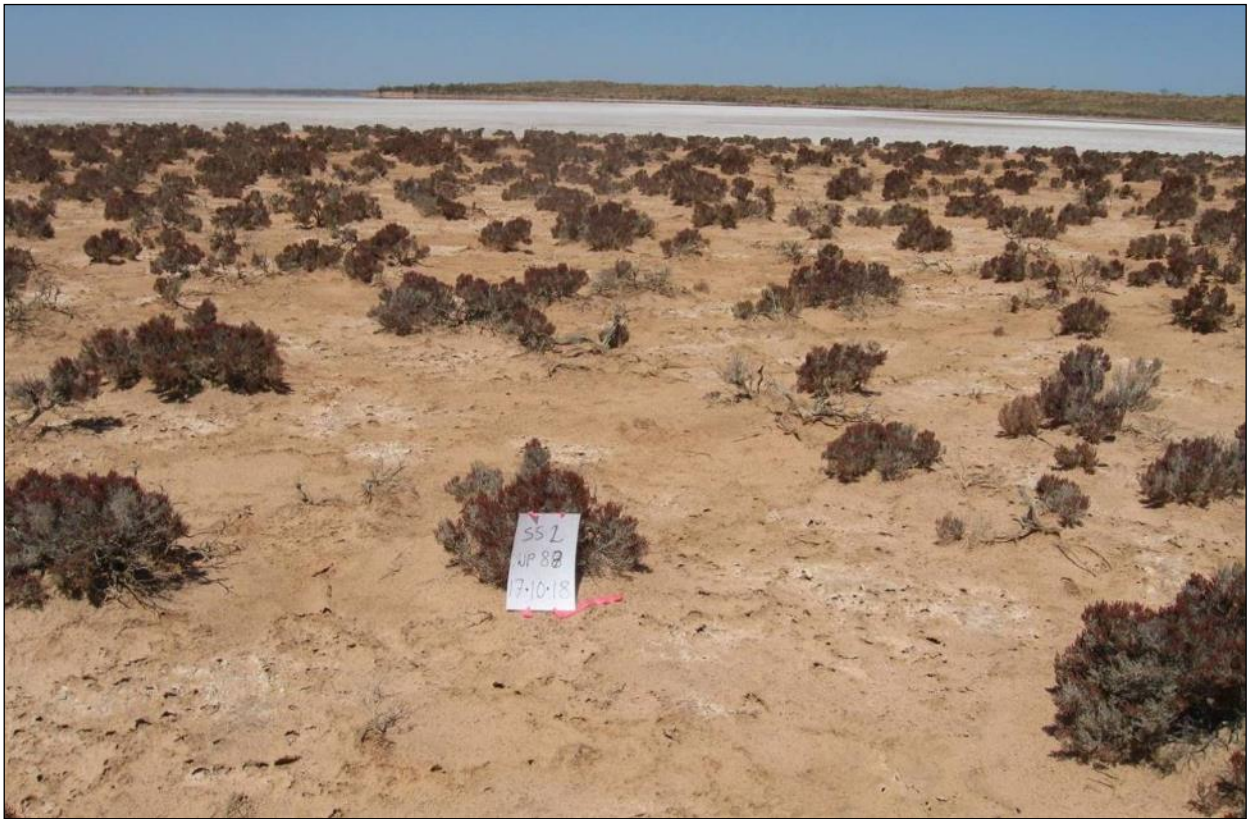

Figure 55 - Lake Sunshine WP88, *Tecticornia* sp. Denny's crossing and *T. auriculata*

The first transect on Lake Sunshine (see Figure 123) was at the south western end of the lake, where there was an extensive samphire flat. The soil near the bare playa (See Figure 55, WP88) was beige crusty kopi and the samphires were mostly *Tecticornia* sp. Denny's crossing and *T. auriculata*. The soil mid-way across the samphire flat changed to red dusty clay (see Figure 54 WP87) and featured *T.* sp. Denny's crossing, *T.* aff. *pruinosa* and *T. auriculata*. Towards the dune at the edge of the lake the soil type changed to fine beige kopi and the samphires featured were *T. laevigata*, *T. calyptrata* and *T.* sp. Denny's crossing.

There were no priority species found at this site.

9.3.2.2 Lake Sunshine S2

Figure 56 - Lake Sunshine S2, WP89, *Tecticornia laevigata*

Figure 57 - Lake Sunshine S2, WP89 soil sampling

Figure 58 - Lake Sunshine S2, WP92 playa edge, *Tecticornia* sp. Sunshine Lake and *T. auriculata*

This site (see Figure 123) was half way along the southern edge of Lake Sunshine, on an extensive samphire flat. The first site was near the red dunes and featured, *T.* laevigata, *T.* aff. pruinosa/auriculata and *T.* sp. Denny's Crossing (see Figure 56, WP89). The soil was red clay with low undulating rises of beige kopi. Near the bare playa (see Figure 58, WP92) the soil was crusty beige kopi and featured *T.* sp. Sunshine Lake P1. This site was problematic for identification.

Priority 1 Tecticornia species found at this site:
Tecticornia sp. Sunshine Lake (K.A. Shepherd et al. KS 867) P1

9.3.2.3 Lake Sunshine S3

Figure 59 – Lake Sunshine, between S2 and S3

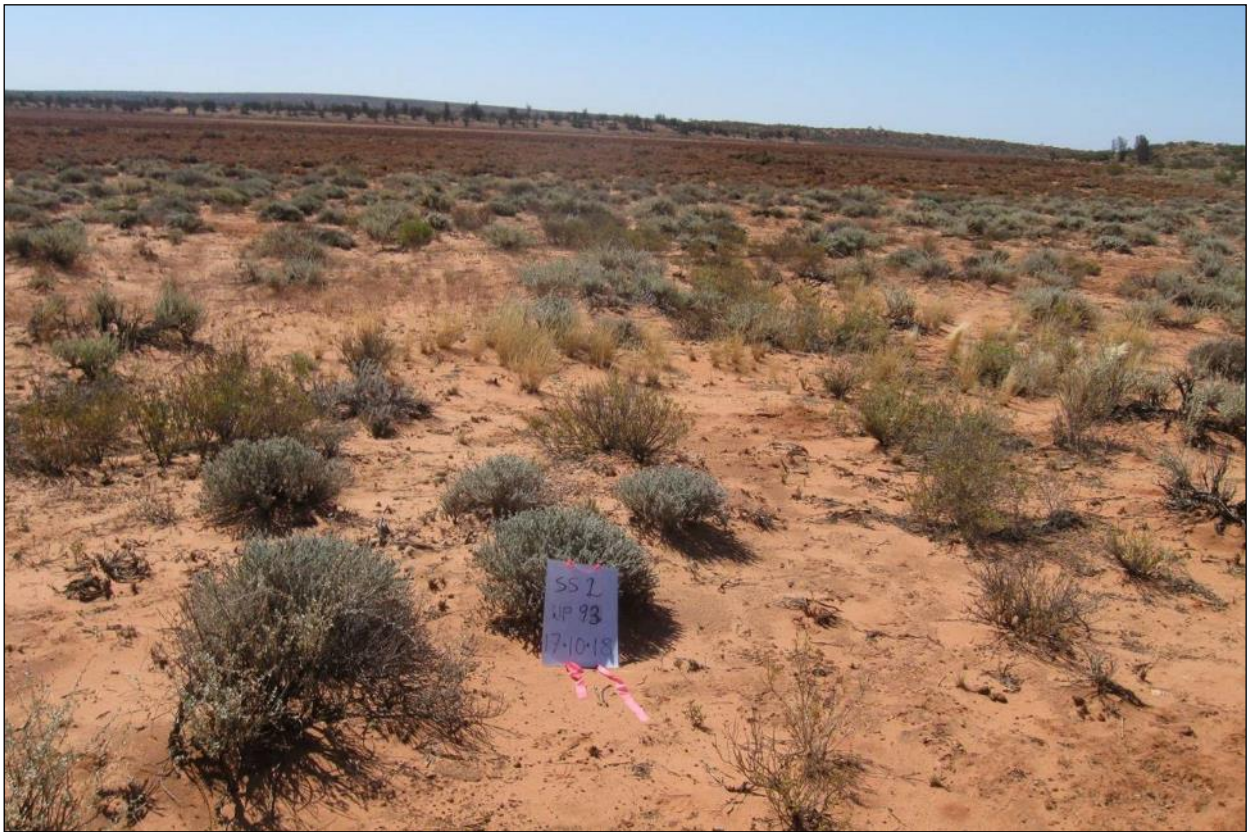

Figure 60 - Lake Sunshine, WP93

Figure 61 - Lake Sunshine S3, WP95, extensive *Tecticornia willisii* in background

Figure 62 - Lake Sunshine WP97

This site was at the north eastern end of Lake Sunshine where there was an extensive samphire flat (see Figure 124). The transect began at the red dune at the edge of the lake and ended at the bare playa. The soil was red dusty clay at the dune edge (WP95, Figure 61) and crusty beige kopi at the edge of the bare playa (WP97, Figure 62). More work needed on samphires.

Priority 1 Tecticornia species found at this site:
T. willisii P1

9.3.3 Ten Mile South Lake 1

Figure 63 - Ten Mile South Lake 1, from air

Figure 64 - Ten Mile South Lake 1, camels at edge

Figure 65 - Ten Mile South Lake 1, lake edge

Figure 66 - Ten Mile South Lake 1 WP45, *Tecticornia laevigata* – sage green

Figure 67 - Ten Mile South Lake 1 WP45, *Tecticornia laevigata* flowering (green), with *T*. sp. Denny's Crossing (reddish)

Figure 68 - Ten Mile South Lake 1 WP46, *Tecticornia laevigata* and *T.* sp. Denny's Crossing

Ten Mile South Lake 1 is to the northeast of Ten Mile South Lake 2, and is south of Ten Mile Lake, but not directly connected to either (see Figure 121). The soil was white crusty kopi at the sampling site and samphires were mostly *Tecticornia laevigata* and *T.* sp. Denny's Crossing (see Figure 66, Figure 67 and Figure 68).

There were no priority species found at this site.

9.3.4 Ten Mile South Lake 2

Figure 69 - Ten Mile South Lake 2

Figure 70 - Ten Mile South Lake 2

Figure 71 - Ten Mile South Lake 2 WP42, *Tecticornia indica* subsp. *bidens*

Figure 72 - Ten Mile South Lake 2 WP42, *Tecticornia indica* subsp. *bidens*

Figure 73 - Ten Mile South Lake 2 WP43, *Tecticornia* Christmas Creek

Figure 74 - Ten Mile South Lake 2 WP43, *Tecticornia* Christmas Creek in foreground

Ten Mile South Lake 2 is to the southwest of Ten Mile South Lake 1, and is south of Ten Mile Lake, but not directly connected to either (see Figure 121). The soil at this lake is quite red and appears to be mixed sandy red sediments and Kopi. In the higher zonation *Tecticornia indica* subsp. *bidens* was predominant (see Figure 73) while *Tecticornia* Christmas Creek was found at a slightly lower elevation in the landscape (see Figure 71).

Priority 1 Tecticornia species found at this site:
Tecticornia sp. Christmas Creek (K.A. Shepherd et al. KS 1063) P1

9.3.5 Beyondie Lakes

9.3.5.1 Beyondie 1

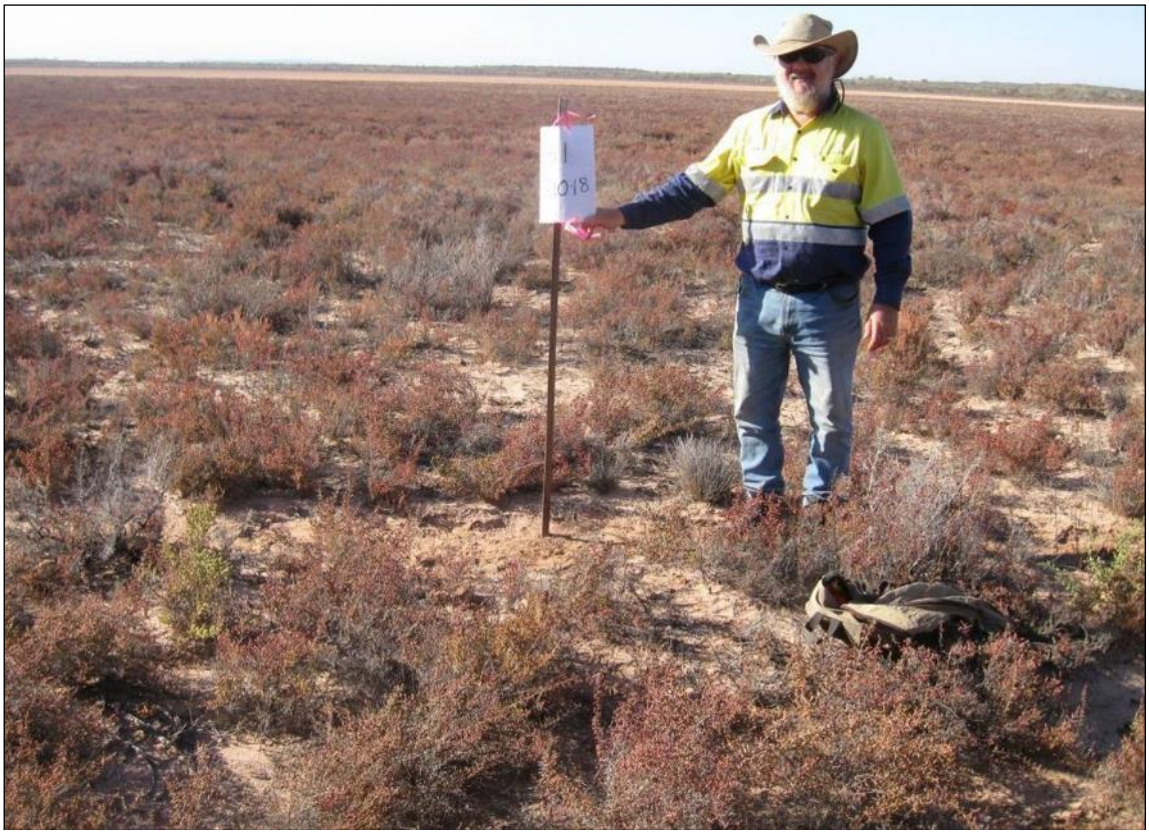

Figure 75 - Beyondie 1, *Tecticornia globulifera*, looking towards bare lake playa

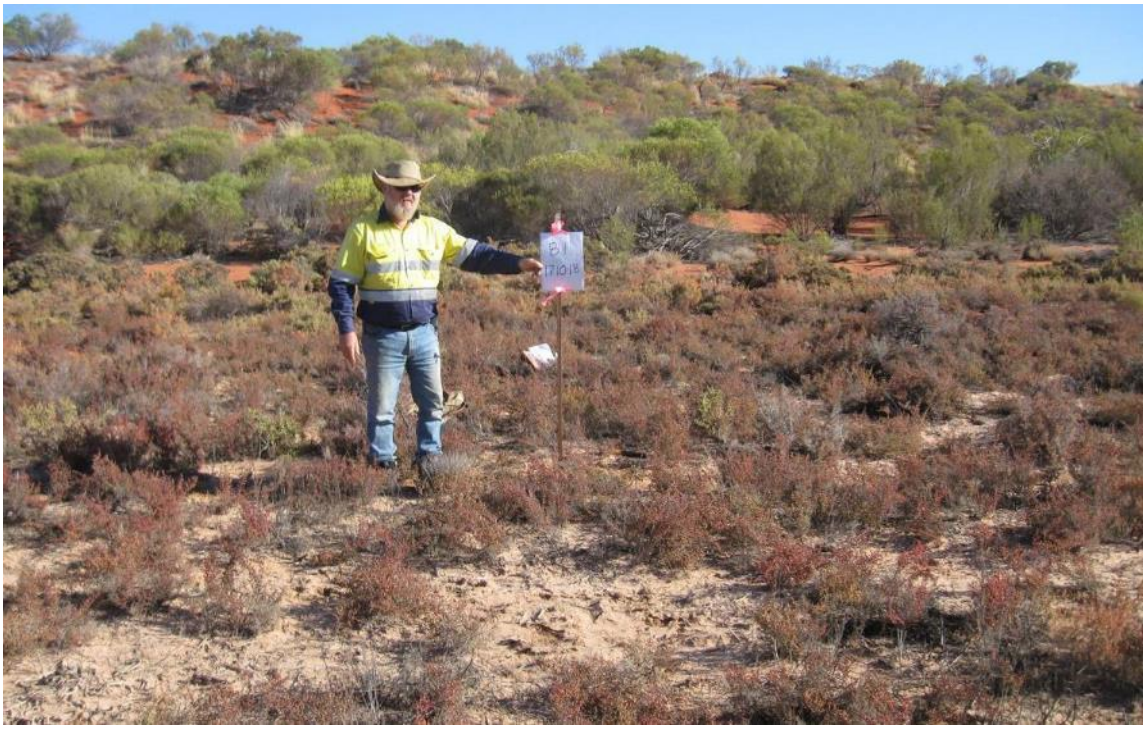

Figure 76 - Beyondie 1, looking towards dune at lake edge, *T. globulifera* in foreground

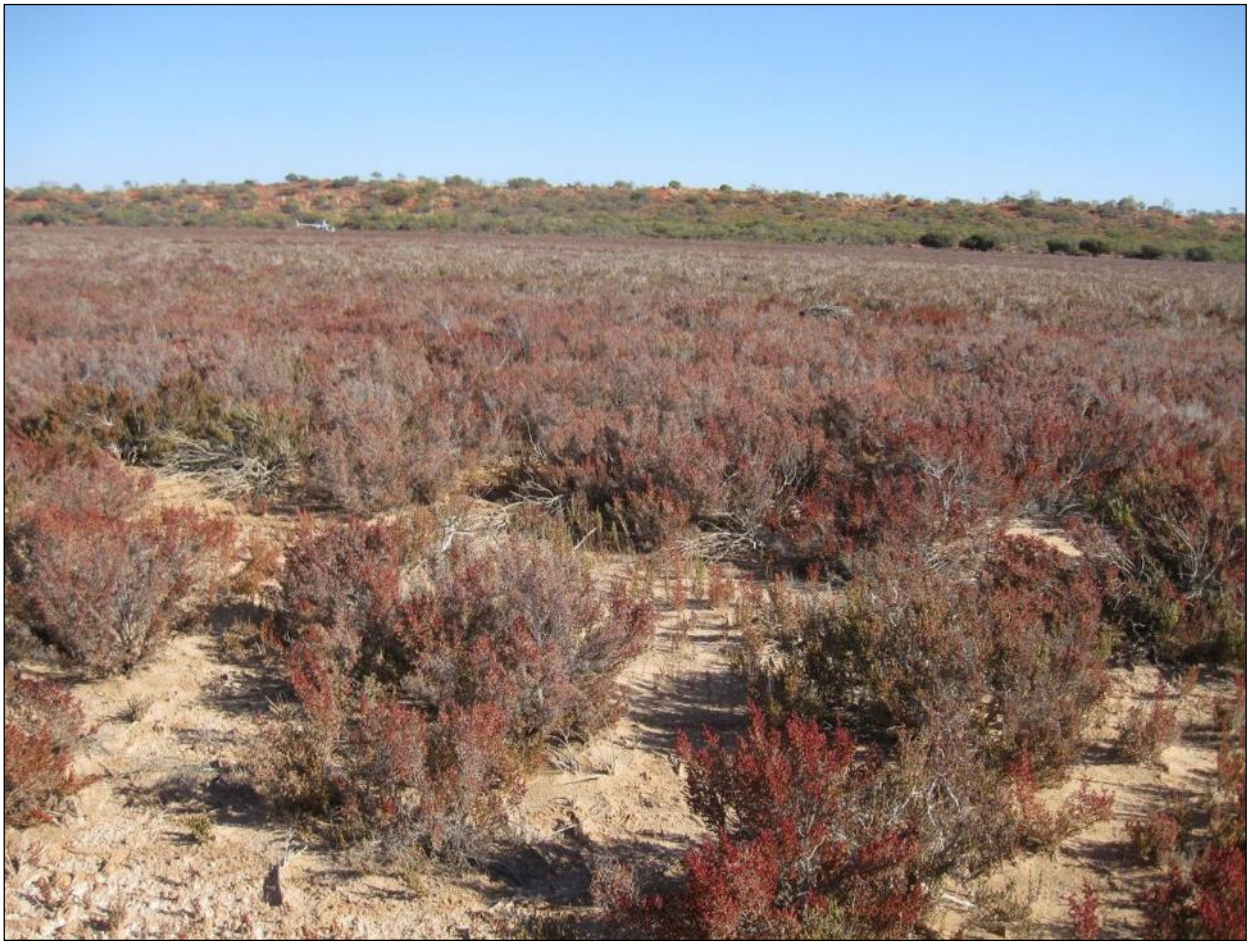

Figure 77 - Beyondie 1 WP53, extensive population of mixed *T. indica* subsp. *bidens*, *T. peltata* and *T.* sp. Sunshine Lake.

This site (see Figure 121) was at the eastern portion of the Beyondie Lakes (Beyondie Lakes total about 966.85ha) to the north of Ten Mile Lake. The extensive samphire flats had red dunes at the edge of the lake and brown/beige kopi in the lower parts. *Tecticornia globulifera* was common in the upper part of the transect, near the dunes (see Figure 75). Further away and lower were *T. indica* subsp. *bidens*, *T. peltata* and *T.* sp. Sunshine Lake (see Figure 77).

Priority 1 Tecticornia species found at this site:
Tecticornia globulifera
T. sp. Sunshine Lake (K.A. Shepherd et al. KS 867) P1

9.3.5.2 Beyondie 2

Figure 78 - Beyondie 2, WP57, bare playa edge, *Tecticornia pergranulata* juveniles

Figure 79 - Beyondie 2, WP58, tiny white snails, *Tecticornia globulifera* and *T.* sp. Denny's Crossing

This site (see Figure 121) was in the central western portion of Beyondie Lakes. The soil at the bare playa was brown grey with a crust and many *T. pergranulata* juveniles, which were drying out and dying. These would have germinated during the last lake fill. *Tecticornia globulifera* was present at WP58, and *T.* sp. Christmas Creek was found at WP60/61

Priority 1 Tecticornia species found at this site:
Tecticornia globulifera
T. sp. Christmas Creek (K.A. Shepherd et al. KS 1063) P1

9.3.6 T Junction Lake

9.3.6.1 T Junction WP62

Figure 80 - T Junction Lake approach

Figure 81 - T Junction Lake WP62

Figure 82 - T Junction WP62, *Tecticornia auriculata*

Figure 83 - T Junction WP62, herbage including *Scaevola* sp.

T Junction Lake is a small lake of about 465.73ha (see Figure 127). T Junction WP62 appeared to be 'fresh' and featured mostly herbage such as *Scaevola* sp. Samphires appeared to be mostly *Tecticornia auriculata*.

There were no priority species at this site.

9.3.6.2 T Junction WP66

Figure 84 - T Junction WP66

T Junction WP66 (see Figure 127) site vegetation was herbage such as *Frankenia* sp., *Lawrencia* sp. and grasses. There were no samphires here.

9.3.6.3 T Junction WP67

Figure 85 - T Junction WP67, extensive population of Priority 1 *Tecticornia bibenda*

Figure 86 - T Junction WP67, *Tecticornia bibenda*

Figure 87 - T Junction WP67, *Tecticornia bibenda*

Figure 88 - T Junction WP67, *Tecticornia bibenda* shrubs on red 'fluffy' soil

Figure 89 - T Junction WP67, *Tecticornia bibenda* habitat

Figure 90 - T Junction Lake - darker area *Tecticornia bibenda* population

Figure 91 - T Junction Lake, more *Tecticornia bibenda* population – darker area

T Junction WP67 (see Figure 127) was situated in the centre of T Junction Lake, a small lake of about 465.73 ha. There was an extensive healthy population of *Tecticornia bibenda* as can be seen in the photographs above (Figure 90 and Figure 91).

Priority 1 Tecticornia species found at this site:
Tecticornia bibenda

9.3.6.4 T Junction Lake WP72

Figure 92 - T Junction Lake WP72, *Tecticornia bibenda* (centre) and *T. laevigata*

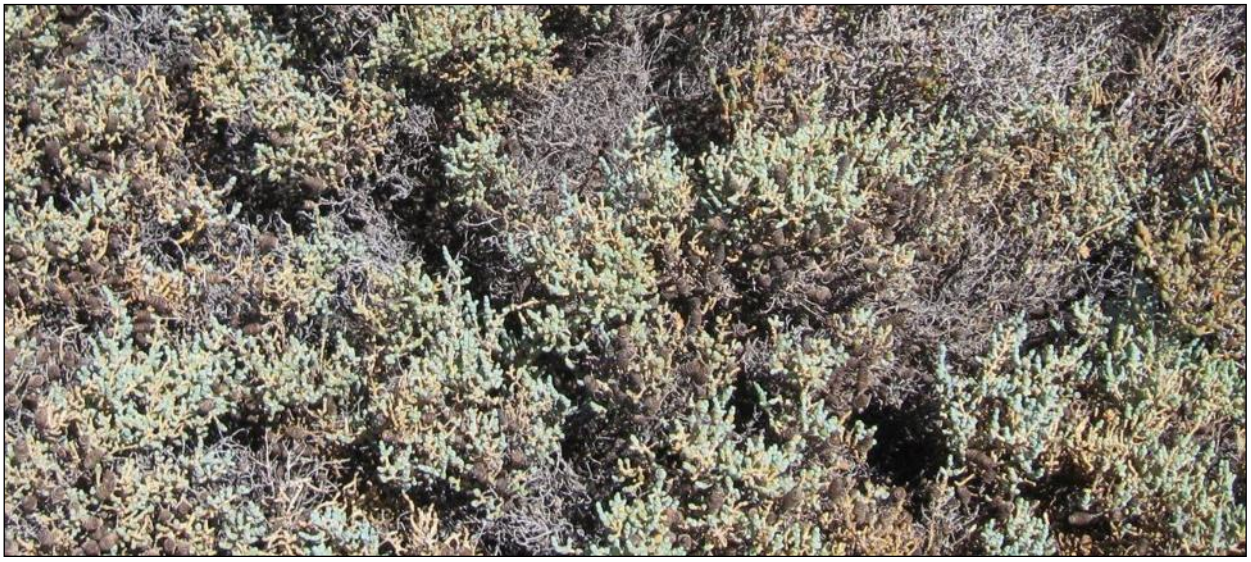

Figure 93 - T Junction WP72, *Tecticornia laevigata*

T Junction WP72 (see Figure 127) was situated along the southern shore of the north eastern portion of the Lake. *Tecticornia bibenda* was common scattered among the predominantly *T. laevigata* samphire vegetation (see Figure 92). The vegetation was in a band of about 50m between bare playa on one side and *Lawrencia helmsii*/grassland then trees on the other.

Priority 1 Tecticornia species found at this site:
Tecticornia bibenda

Figure 94 – T Junction WP73, *Tecticornia bibenda* along shoreline at foot of red dune

The southern shoreline of T Junction Lake (see Figure 127and Figure 94 to Figure 97) was flown at low altitude to ascertain the extent of the *Tecticornia bibenda* population. This species appears to be common at this lake.

Figure 95 - T Junction WP74, reddish *T. bibenda* at foot of dunes

Figure 96 - T Junction WP74, reddish *T. bibenda* at foot of dunes

Figure 97 - T Junction WP74, reddish *T. bibenda* at foot of dunes

9.3.7 T Junction South

Figure 98 - T Junction South WP77

Figure 99 - T Junction South WP77, *Tecticornia auriculata*

Figure 100 - T Junction South WP77, *Tecticornia auriculata*

T Junction South is a small (393.8 ha) largely vegetated lake to the south of T Junction Lake and to the north of Lake Sunshine. Two sites were visited on T Junction South, WP76 and WP77 (see Figure 127). There were Casuarina trees on the playa with samphires scattered throughout. This site probably warrants more samphire collections.

There were no priority species found at this site.

9.3.8 North Sunshine Lake

Figure 101 - North Sunshine Lake WP78, *Tecticornia bibenda* on red dune

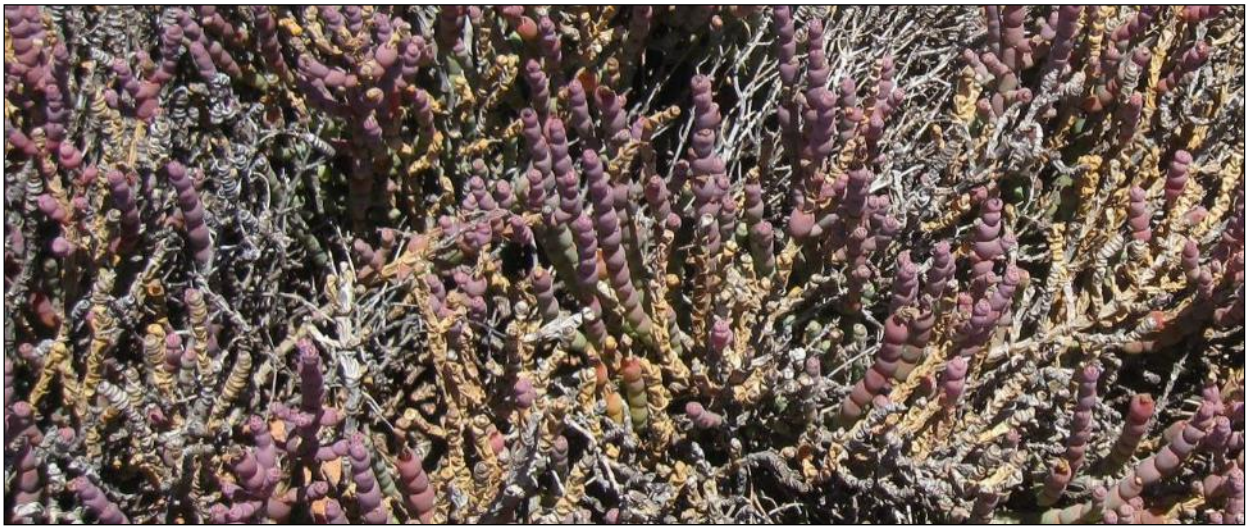

Figure 102 - North Sunshine Lake WP78, *T. bibenda* closeup

Figure 103 - North Sunshine Lake WP79, *Tecticornia bibenda*

Figure 104 - North Sunshine Lake WP80, *Tecticornia bibenda*

Figure 105 - North Sunshine Lake WP80, *Tecticornia bibenda*, *Lawrencia* sp. behind

North Sunshine Lake is north of Lake Sunshine (see Figure 127) but not continuous with it. Five sites were visited, WP78, WP79, WP80, WP81 and WP82. All except WP82 had healthy populations of *Tecticornia bibenda* (see Figure 101 to Figure 105), mostly on dunes beside the Lake.

Priority1 Tecticornia species found at North Sunshine Lake:
Tecticornia bibenda

9.3.9 Vegetated Lakes 1 and 2

Figure 106 - Vegetated Lake 1, WP83, *Tecticornia laevigata*

Figure 107 - Vegetated Lake 1, WP83, zonation of samphire species

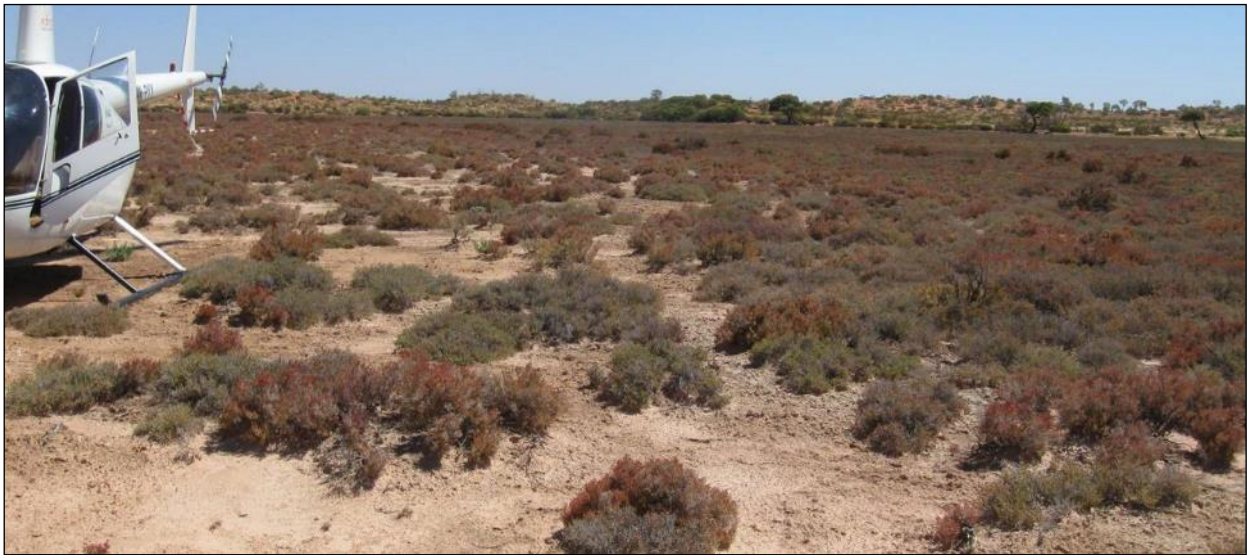

Figure 108 - Vegetated Lake 2, WP84, mixed samphires

Figure 109 - Vegetated Lake 2, WP84

Figure 110 - Vegetated Lake 2, Wp 84, mixed samphires

These two Lakes are to the west of the bottom of Lake Sunshine but are not continuous with it (see Figure 122). One site in each lake was visited, WP83 and WP84 and samples taken of the samphires. Species were *Tecticornia* sp. Denny's Crossing, *T. laevigata*, *T. indica* subsp. *bidens* and *T. calyptrata*.

There were no priority samphire species collected at these two sites, though the photographs indicate the presence of T. willisii and this species was found here during the extensive Phoenix survey.

9.3.10 Sunshine Concentrator Lake

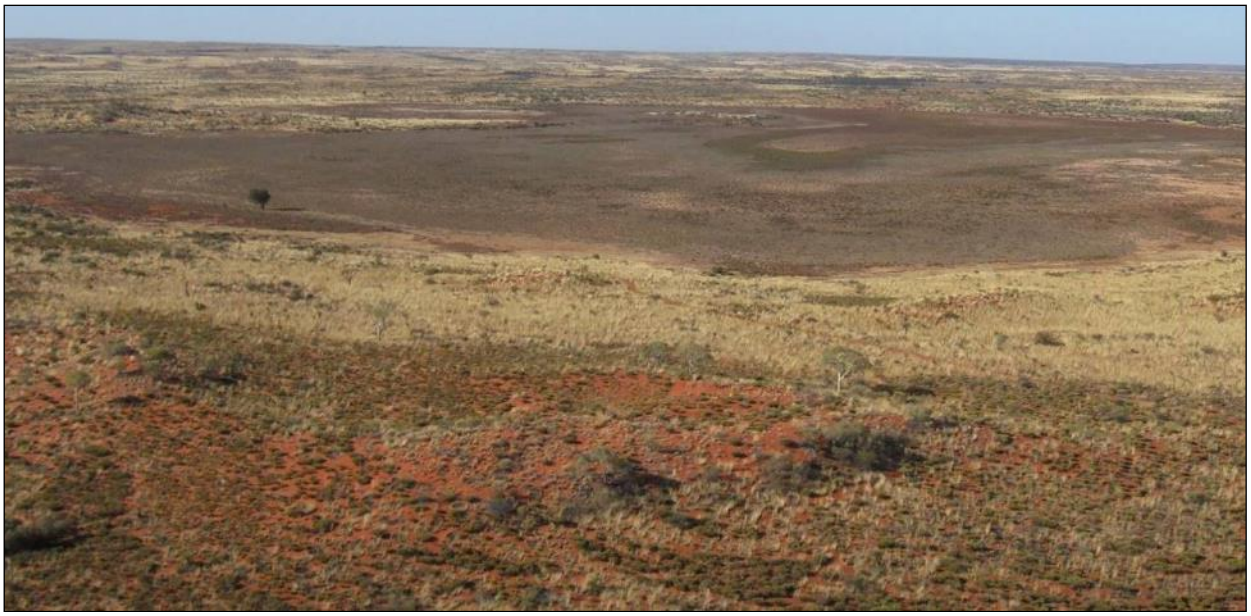

Figure 111 - Approaching Sunshine Concentrator Lake

Figure 112 - Sunshine Concentrator Lake, WP49/50

Figure 113 - Sunshine Concentrator Lake, WP51

This lake is to the southwest of the two vegetated Lakes 1 and 2 (see Figure 122) and it is proposed to be used as a concentrator pond in the process of obtaining Potash from the lake brines. Three sites were visited at this lake, WP49, WP50 and WP51 and samphire samples taken for identification. *T. willisii* was collected here by Phoenix but *actis* collected only *T.* sp. Denny's Crossing, a somewhat similar species. Phoenix's survey included two long transects on this lake which was quite intensive.

Priority 1 Tecticornia species found at this site:
Tecticornia. sp. Christmas Creek (K.A. Shepherd et al. KS 1063) P1

9.3.11 Terminal Lake

Figure 114 - Terminal Lake from the air, *Tecticornia bibenda* at foot of red dunes

Figure 115 - Terminal Lake from air, *Tecticornia bibenda* at the edge of the lake - larger reddish patches

Terminal Lake (1748.03 ha) is the more easterly of the two lakes to the north of Lake Sunshine (see Figure 126). It had a largely vegetated playa and Casuarina trees extending onto the playa. *Tecticornia bibenda* appeared to be common around most of the lake – low flying in the helicopter validated this.

Priority 1 Tecticornia species found at this lake:
Tecticornia bibenda

9.3.12 Yanerri Lake

Figure 116 - Yanerri Lake, WP101, mixed *Tecticornia* sp. Denny's Crossing, *T. willisii, T. indica* subsp. *bidens* and *T.* sp. Christmas Creek

Figure 117 - Yanerri Lake, WP101

Figure 118 - Yanerri Lake, WP101, *Tecticornia* Christmas Creek

Yanerri Lake (732.23 ha) is the more westerly of the two lakes to the north of Lake Sunshine but not connected to it (see Figure 126). This was a more open kopi playa lake than Terminal Lake with extensive samphire flats featuring *Tecticornia* sp. Denny's Crossing, *T. willisii*, *T. indica* subsp. *bidens* and *T.* Christmas Creek.

There was a long wetland at the side of the Lake with only a dune separating it from the Lake – WP99 and WP100 – where *Tecticornia bibenda* was growing at the foot of the dunes. *Tecticornia bibenda* was also seen at small wetland WP102 on the north west of Yanerri, on the main inlet - Ligaran Creek, and in patches all along this creek. It appears common in this area.

Priority1 Tecticornia found at these sites:
Tecticornia bibenda
T. sp. Christmas Creek (K.A. Shepherd et al. KS 1063) P1
T. willisii P1

10 Species Lists – *actis* Site Visit

10.1 Species List actis

Tecticornia auriculata
T. bibenda P1
T. calyptrata
T. sp. Denny's Crossing
T. globulifera P1
T. indica subsp. bidens
T. indica subsp, bidens (denticulate)
T. indica subsp, leiostachya
T. laevigata
T. laevigata/pruinosa hybrid?
T. peltata
T. pergranulata
T. aff pruinosa
T. aff pruinosa/auriculata hybrid?
T. pterygosperma subsp. denticulata
T. undulata
T. sp. Christmas Creek (K.A. Shepherd et al. KS 1063) P1
T. willisii P1
T. sp. Sunshine Lake (K.A. Shepherd et al. KS 867) P1
T. sp. NOID

10.2 Species List Phoenix

Tecticornia auriculata
T. calyptrata
T. sp. Denny's Crossing
T. globulifera P1
T. indica subsp. bidens
T. indica subsp, leiostachya
T. laevigata
T. peltata
T. pergranulata subsp. elongata
T. pergranulata subsp. pergranulata
T. pruinosa
T. pterygosperma subsp. denticulata
T. sp. sterile (Groups 1 to 6)
T. sp. Christmas Creek (K.A. Shepherd et al. KS 1063) P1
T. willisii P1
T. sp. Sunshine Lake (K.A. Shepherd et al. KS 867) P1
T. undulata
T. verrucosa? (Maybe T. bibenda P1)

10.3 Comparison of P1 results – Phoenix and actís

Species	TML	WP14 SW	Red Clay Pan	TM Lake 1	TM Lake 2	SS Lake	T Junc	Sth T Junc	Nth SS	B1	B2	SS Conc	Lake 1	Lake 2	Term	Yann	TM Conc
T. bibenda P1							x		x						x	x	
T. globulifera P1	x		x							xx	xx						
T. sp. Christmas Creek (K.A. Shepherd et al. KS 1063) P1	x				x					x	xx	xx				x	
T. willisii P1	xx					x					x	x	x	x		x	x
T. sp. Sunshine Lake (K.A. Shepherd et al. KS 867)	xx			x		xx				x							x

Abbreviations of names
TML -Ten Mile Lake
Red Clay Pan - South Ten Mile Lake
TM Lake #1 -Ten Mile South Lake #1
TM lake #2 - Ten Mile South Lake #2
SS Lake– Lake Sunshine
T Junc – T Junction Lake
Sth T Junc – South T Junction Lake
Nth SS – North Sunshine Lake
B1 – Beyondie Lake #1
B2 – Beyondie Lake #2

SS Conc – Sunshine Concentrator
Lake 1 – Vegetated Lake #1
Lake 2 – Vegetated Lake #2
Term – Terminal Lake
Yann – Yannery Lake
TM Conc – Ten Mile Concentrator (Phoenix)

Black x – *actís*, Red x - Phoenix

Table 3 - *Tecticornia* total sites

Site	GPS Location	Date	Samphire ID	ID confidence	Notes
Ten Mile Lake					
T1 0-38	WP10	16.10.2018	T. indica bidens	y	
			T. Denny's Crossing	y	
			T. indica subsp. leiostachya	y	
38-45		16.10.2018	T. Christmas Creek	y	
	WP11		T. indica bidens	y	Road
48-68		16.10.2018	T. Christmas Creek	y	
			T. pruinosa	y	
68-93		16.10.2018	T. Christmas Creek	y	
			T. indica subsp. leiostachya	y	
			T. indica subsp. bidens	y	
			T. willisii	y	
93-116	WP12	16.10.2018	T. indica subsp. bidens	y	Bare patch
	WP13				Road
136-159		16.10.2018	T. willisii	y	
			T. Christmas Creek	y	
159		16.10.2018	T. indica subsp. bidens	y	
			T. Christmas Creek	y	
T2 1-6m	WP2a	16.10.2018	T. Sunshine Lake	y	
6-16m	WP2b	16.10.2018	T. peltata	y	
16-41m	WP2c	16.10.2018	T. willisii	y	
			T. peltata	y	
41-52	WP2d	16.10.2018	T. Sunshine Lake	y	
			T. pruinosa	y	
			T. peltata	y	
			T. undulata	y	
			T. Denny's Crossing	y	

Site	GPS Location	Date	Samphire ID	ID confidence	Notes
52-78	WP2e	16.10.2018	T. indica subsp. leiostachya	y	
			T. peltata	y	
			T. willisii	y	
78-96		16.10.2018	T. indica subsp. bidens	y	
(96-100 road)	WP2F		T. indica subsp. leiostachya	y	
			T. willisii	y	
100-110	WP2g	16.10.2018	T. indica subsp. bidens	y	
			T. indica subsp. leiostachya	y	
			T. Denny's Crossing	y	
T2 Random Upper profile		16.10.2018	T. peltata	y	
			T. indica subsp. bidens	y	
			T. Denny's Crossing	y	
			T. willisii	y	
			T. auriculata	y	
Between T2 and T2A	WP3				photo of lake
T2A	WP4	16.10.2018	T. peltata	y	Photos, flowering
	WP6	16.10.2018	T. Christmas Creek	y	
	WP7	16.10.2018	T. Christmas Creek	y	
Small wetland	WP14	16.10.2018	T. indica subsp. bidens	y	flowering
			T. Denny's Crossing	y	
	WP15		T. indica subsp. bidens	y	
			T. Denny's Crossing	y	

Site	GPS Location	Date	Samphire ID	ID confidence	Notes
T3 0-49	WP16	16.10.2018	T. indica subsp. bidens	y	
			T. indica subsp. leiostachya	y	
			Tecticornia NOID	n	no flowers or seed, fimbriate margins
			T. Denny's Crossing	y	
49-58	WP17	16.10.2018	T. indica subsp. bidens	m	denticulate
			T. laevigata	y	
			Tecticornia NOID	n	no flowers or seed, fimbriate margins
58-100	WP18	16.10.2018	T. indica subsp. bidens	m	denticulate
			T. laevigata	y	
			T. Denny's Crossing	y	
			T. willisii	y	
100-178		16.10.2018	T. indica subsp. bidens	m	denticulate
			T. willisii	y	
192		16.10.2018	T. willisii	y	
			T. indica subsp. bidens	m	denticulate
			T. laevigata	y	
229-270	WP19	16.10.2018	T. laevigata	y	
			T. willisii	y	
374-415	WP20 (288m)	16.20.2018	T. indica subsp. bidens	m	denticulate
	WP21 (road 374)		T. willisii	y	
			T. Denny's Crossing	y	3 tiers of flowers all male
T4 0-44	WP22	16.10.2018	T. peltata	y	
			T. undulata	m	similar to T2 41-52
			T. willisii	y	
44-165	WP23 (165m)	16.10.2018	T. peltata	y	no seed
			T. undulata	m	similar to T2 41-52
			T. willisii	y	

Site	GPS Location	Date	Samphire ID	ID confidence	Notes
T4	WP23-24	16.10.2018	T. peltata	y	no seed
			T. undulata	m	
			T. indica subsp. bidens	m	
			T. willisii	y	
T4	WP24-25	16.10.2018	T. indica subsp. bidens	m	
			T. undulata	y	
			T. willisii	y	
T4	WP25-26	16.10.2018	T. indica subsp. bidens	y	
			T. indica subsp. leiostachya	y	
			T. willisii	y	
			Tecticornia NOID	n	no flowers or seed, fimbriate margins, blue-green spindly
T4	WP26-27	16.10.2018	T. indica subsp. bidens	y	
			T. Denny's Crossing	m	
	WP28	16.10.2018	T. laevigata	y	
			T. willisii	y	
T5	WP30-31	16.10.2018	T. Sunshine Lake	y	
			T. peltata	y	
T5	Before WP31, half way to road	16.10.2018	T. peltata	y	
			T. Sunshine Lake	y	
T5	WP31	16.10.2018	T. willisii	y	
T5	WP32-33	16.10.2018	T. indica subsp. bidens	y	
			T. indica subsp. bidens	y	small almost round seed spike
T5	WP33 (WP34 road)	16.10.2018	T. indica subsp. bidens	y	
			T. indica subsp. bidens	y	small almost round seed spike

Site	GPS Location	Date	Samphire ID	ID confidence	Notes
			T. willisii	y	
			T. Denny's Crossing?	m	same as WP25-26
T5	WP35-36	16.10.2018	T. globulifera	y	
			T. willisii	y	
T5	WP37	16.10.2018	T. globulifera	y	
			T. willisii	y	
			T. indica subsp. bidens	y	
Red Clay Pan	WP40	16.10.2018	T. indica subsp. bidens	y	
			T. indica subsp. leiostachya	y	
			T. auriculata	m	gold brown seed darker at umbilicus, minute granulations along long edge
			T. globulifera	y	
Ten Mile Sth Lake #2	WP42-43	16.10.2018	T. Christmas Creek	y	
			T. indica subsp. bidens	y	
	WP43-44	16.10.2018	T. indica subsp. leiostachya	y	
			T. Christmas Creek	y	
Ten Mile South Lake #1	WP45	16.10.2018	T. laevigata	y	
			T. Denny's Crossing?	m	
	WP47		T. laevigata	y	
			T. Denny's Crossing?	m	
SS Conc Lake	WP49-50	16.10.2018	T. laevigata	y	
			T. laevigata hybrid?	m	
			T. indica subsp. bidens	m	denticulate
			T. Denny's Crossing	m	

Site	GPS Location	Date	Samphire ID	ID confidence	Notes
			T. Christmas Creek	y	
			T. calyptrata	y	
Beyondie 1	WP52	17.10.2018	T. Denny's Crossing	y	
			T. indica subsp. bidens	m	denticulate
			T. globulifera	y	
	WP52-53		T. Denny's Crossing	y	
			T. indica subsp. bidens	y	
			T. Sunshine Lake	y	
			T. globulifera	y	
	WP53-54		T. peltata	y	
	WP54-55		T. peltata	y	
			T. globulifera	y	
	WP55-56		T. peltata	y	
Beyondie 2	WP57-58	17.10.2018	T. pergranulata	y	
			T. Christmas Creek	y	
			T. Denny's Crossing	y	
	WP58-59		T. globulifera	y	
			T. Denny's Crossing	y	red
	WP59-60		T. indica subsp. bidens	y	
			T. Denny's Crossing	y	green
	WP60-61		T. undulata Christmas Creek	y	
			T. indica subsp. bidens	y	
			T. Denny's Crossing	y	reddish
T Junction	WP62	17.10.2018	T. auriculata	y	see drawing
	WP63		T. auriculata	y	see drawing
	WP64		T. auriculata	y	see drawing

Site	GPS Location	Date	Samphire ID	ID confidence	Notes
	WP67		T. bibenda	y	
			T. indica subsp. bidens	m	
			T. Denny's Crossing	m	probably, no seed or flower
	WP72		T. bibenda	y	
			T. laevigata	y	
			T. indica subsp. bidens	m	
			T. Denny's Crossing	y	apple green
	WP73		T. bibenda	y	
	WP74		T. bibenda	y	
	WP75		T. Denny's Crossing	y	
			T. auriculata	y	see drawing
			T. indica subsp. bidens	y	
South T Junction	WP76		T. pterygosperma subsp. denticulata	y	
			T. indica subsp. bidens	y	
			T. Denny's Crossing	y	
			T. calyptrata	y	
	WP77		T. laevigata	y	
			T. auriculata	m	
			T. Denny's Crossing	y	
			T. calyptrata	y	
			T. indica subsp. leiostachya	m	
North Sunshine Lake	WP78	17.10.2018	T. bibenda	y	
			T. auriculata	y	
			T. calyptrata	y	
			T. laevigata	y	
			T. Denny's Crossing	y	

Site	GPS Location	Date	Samphire ID	ID confidence	Notes
	WP79		T. bibenda	y	
	WP80		T. bibenda	y	
			T. indica subsp. leiostachya	m	
			T. Denny's Crossing	y	
	WP81		T. bibenda	y	
	WP82		T. indica subsp. leiostachya	m	
Vegetated Lake 1	WP83	17.10.2018	T. auriculata	y	see drawing WP75
			T. laevigata	y	
			T. laevigata/pruinosa hybrid?	m	similar seed spike to T laevigata but elongated
Vegetated Lake 2	WP84	17.10.2018	T. Denny's Crossing	y	
			T. laevigata	y	round yellow brown seed
			T. indica subsp. bidens	y	
			T. calyptrata	y	
Lake Sunshine	WP85	17.10.2018	T. laevigata	y	
			T. Denny's Crossing	y	
			T. calyptrata	y	
	WP86		T. laevigata	y	
			T. Denny's Crossing	y	
	WP87		T. auriculata	y	
			T. aff pruinosa	n	soft yellow seed, short seed spikes
	WP88		T. Denny's Crossing	y	
			T. aff pruinosa/auriculata	n	same as WP92/90
			T. auriculata	y	
	WP89		T. laevigata	y	
			T. Denny's Crossing	y	
	WP90		T. Denny's Crossing	n	Apple green articles, gold seed

Site	GPS Location	Date	Samphire ID	ID confidence	Notes
			T. aff pruinosa/auriculata	n	same as WP92/90 - seeds in sellotape
	WP92		T. Sunshine Lake	y	
			T. auriculata	y	
	WP94		T. Denny's Crossing	y	
			T. willisii	y	
	WP95-96		T. willisii	y	same as WP76, seed in sellotape
Yannery Lake	WP99		T. bibenda	y	extensive around edges
	WP100		T. bibenda	y	
	WP101	17.10.2018	T. Denny's Crossing	y	
			T. willisii	y	
			T. undulata Christmas Creek	y	
			T. indica bidens	y	
Terminal Lake	WP98	17.10.2018	T. bibenda	y	extensive - all around edges on dunes
Ligaran Creek	WP102	17.10.2018	T. bibenda	y	creek line

Table 4 - *Tecticornia* spp per site**,** *actís* Survey

Species	TML #1	TML #2	TML #2A	TML #3	TML #4	TML #5	WP14 SW	Red Clay	TM Lake	TM Lake2	SS Lake 1	SS Lake 2	SS Lake 3	T Junc	Sth T Junc	Nth SS	B1	B2	SS Conc	Lake 1	Lake 2	Term	Yann
T. auriculata		x						x			x	x		x		x				x			
T. bibenda P1														x		x						x	x
T. calyptrata											x				x	x			x		x		
T. globulifera P1						x		x									x	x					
T. indica						x													x				
T. indica subsp. bidens	x	x		x	x	x	x	x		x				x	x	x	x	x			x		x
T. indica subsp. bidens denticulate				x		x				x							x						
T. indica subsp. leiostachya	x	x		x	x			x						x	x								
T. laevigata				x	x				x		x	x		x	x	x			x	x	x		
T. laevigata/pruinosa hybrid ?																			x	x			
T. peltata		x	x		x	x											x						
T. pergranulata																		x					
T. aff pruinosa		x									x												
T. aff pruinosa/auriculata											x	x			x								
T. pterygosperma subsp. denticulata															x								
T. undulata		x			x																		
T. aff undulata					x																		
T. sp. Christmas Creek P1	x	x	x							x								x	x				x
T. sp. Denny's Crossing	x	x		x	x		x		x		x	x	x	x	x	x	x	x	x		x		x
T. willisii P1	x	x		x	x	x							x										x
T. sp NOID spindly				x	x																		
T. sp. Sunshine Lake P1		x				x						x					x						

Table 5 - Sites with Priority 1 species, *actis* Survey

Species	TML #1	TML #2	TML #2A	TML #3	TML #4	TML #5	Red Clay P	TM Lake 1	TM Lake2	SS Lake 1	SS Lake 2	SS Lake 3	T Junc	Sth T Junc	Nth SS	B1	B2	SS Conc	Lake 1	Lake 2	Term	Yann
Tecticornia bibenda P1													x		x						x	x
T. globulifera P1						x	x									x	x					
T. sp. Christmas Creek (K.A. Shepherd et al. KS 1063) P1	x	x	x						x								x	x				x
T. willisii P1	x	x		x	x	x						x										x
T. sp. Sunshine Lake (K.A. Shepherd et al. KS 867)		x				x					x					x						

Abbreviations of names
TML #1 -Ten Mile Lake Transect #1
TML #2 - Ten Mile Lake Transect #2
TML #3 – Ten Mile Lake Transect #3
TML #4 - Ten Mile Lake Transect #4
TML #5 - Ten Mile Lake Transect #5
Red Clay Pan - South Ten Mile Lake
TM Lake #1 -Ten Mile South Lake #1
TM lake #2 - Ten Mile South Lake #2
SS Lake #1 – Lake Sunshine Transect #1
SS Lake #2 – Lake Sunshine Transect #2
SS Lake #3 – Lake Sunshine Transect #3
T Junc – T Junction Lake
Sth T Junc – South T Junction Lake
Nth SS – North Sunshine Lake
B1 – Beyondie Lake #1
B2 – Beyondie Lake #2
SS Conc – Sunshine Concentrator
Lake 1 – Vegetated Lake #1
Lake 2 – Vegetated Lake #2
Term – Terminal Lake
Yann – Yannery Lake

Table 6 - *Tecticornia* spp Phoenix Surveys

Tecticornias recorded in Phoenix Survey
Tecticornia aff. sp. Dennys Crossing (KS 552)
Tecticornia auriculata
Tecticornia calyptrata
Tecticornia globulifera (P1 WC Act)
Tecticornia indica subsp. bidens
Tecticornia indica subsp. leiostachya
Tecticornia laevigata
Tecticornia peltata
Tecticornia pergranulata subsp. elongata
Tecticornia pergranulata subsp. pergranulata
Tecticornia pruinosa
Tecticornia pterygosperma subsp. denticulata
Tecticornia sp.
Tecticornia sp. (Group 3 0r 5)
Tecticornia sp. (sterile) ? [group 6]
Tecticornia sp. (sterile) [group 1]
Tecticornia sp. (sterile) [group 2]
Tecticornia sp. (sterile) [group 3]
Tecticornia sp. (sterile) [group 4]
Tecticornia sp. (sterile) [group 5]
Tecticornia sp. Christmas Creek (K.A. Shepherd et al. KS 1063) (P1 WC Act)
Tecticornia sp. Dennys Crossing (K.A. Shepherd & J. English KS 552)
T. willisii P1
Tecticornia sp. nov. 1 (aff. pruinosa/ laevigata)
Tecticornia sp. nov. 2 (aff. pruinosa/undulata)
Tecticornia sp. Sunshine Lake (K.A. Shepherd et al. KS 867) (P1 WC Act)
Tecticornia sp. Yoothapina Station (A.A. Mitchell 883)
Tecticornia undulata
Tecticornia verrucosa

10.4 Maps of Waypoints and Lake Areas, actís Site Visit

10.4.1 Lake areas

Beyondie Lakes – 966.85 ha
Ten Mile Lake – 4526.88 ha
Lake Sunshine - 2944.97 ha
Unnamed (above Sunshine) – 1193.64 ha (North Sunshine Lake)
Yanerri – 732.23 ha (main lake) + 54.03 ha (smaller lake to the right)
Terminal Lake – 1748.03 ha
T Junction South – 393.8 ha
T Junction North – 465.73 ha

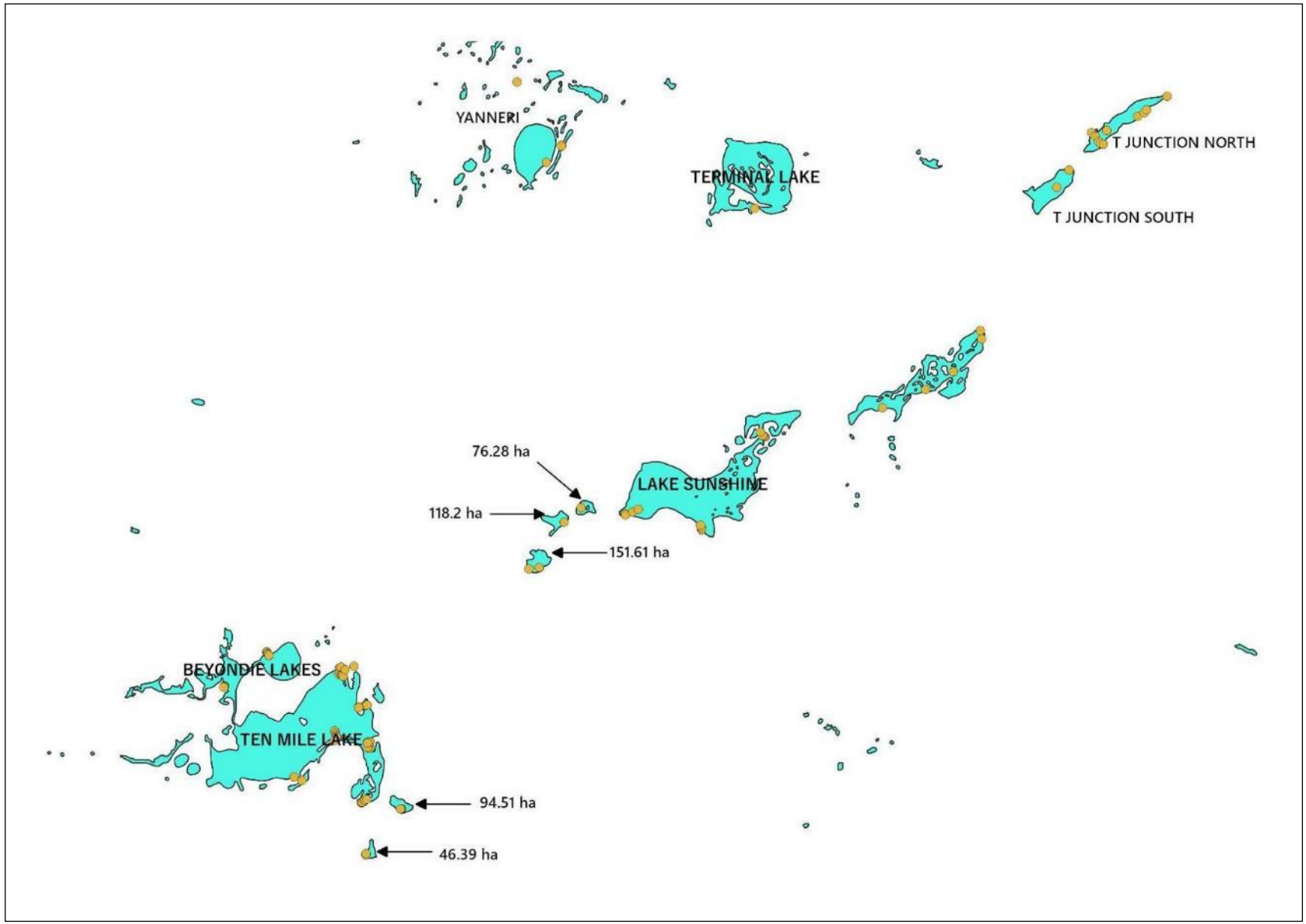

Figure 119 – *actís* survey, Lake names and areas

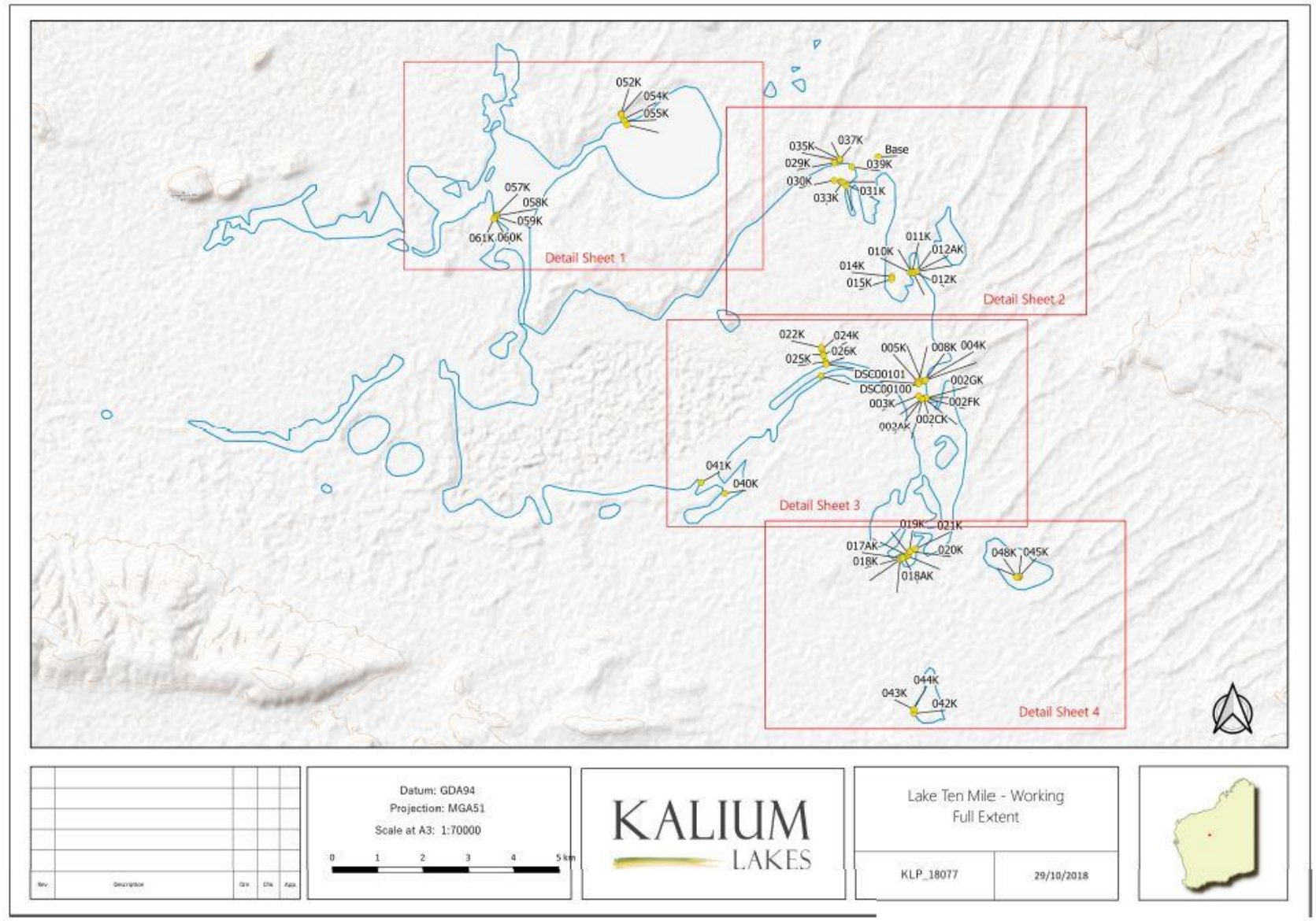

Figure 120 - Way Points *actís* Survey

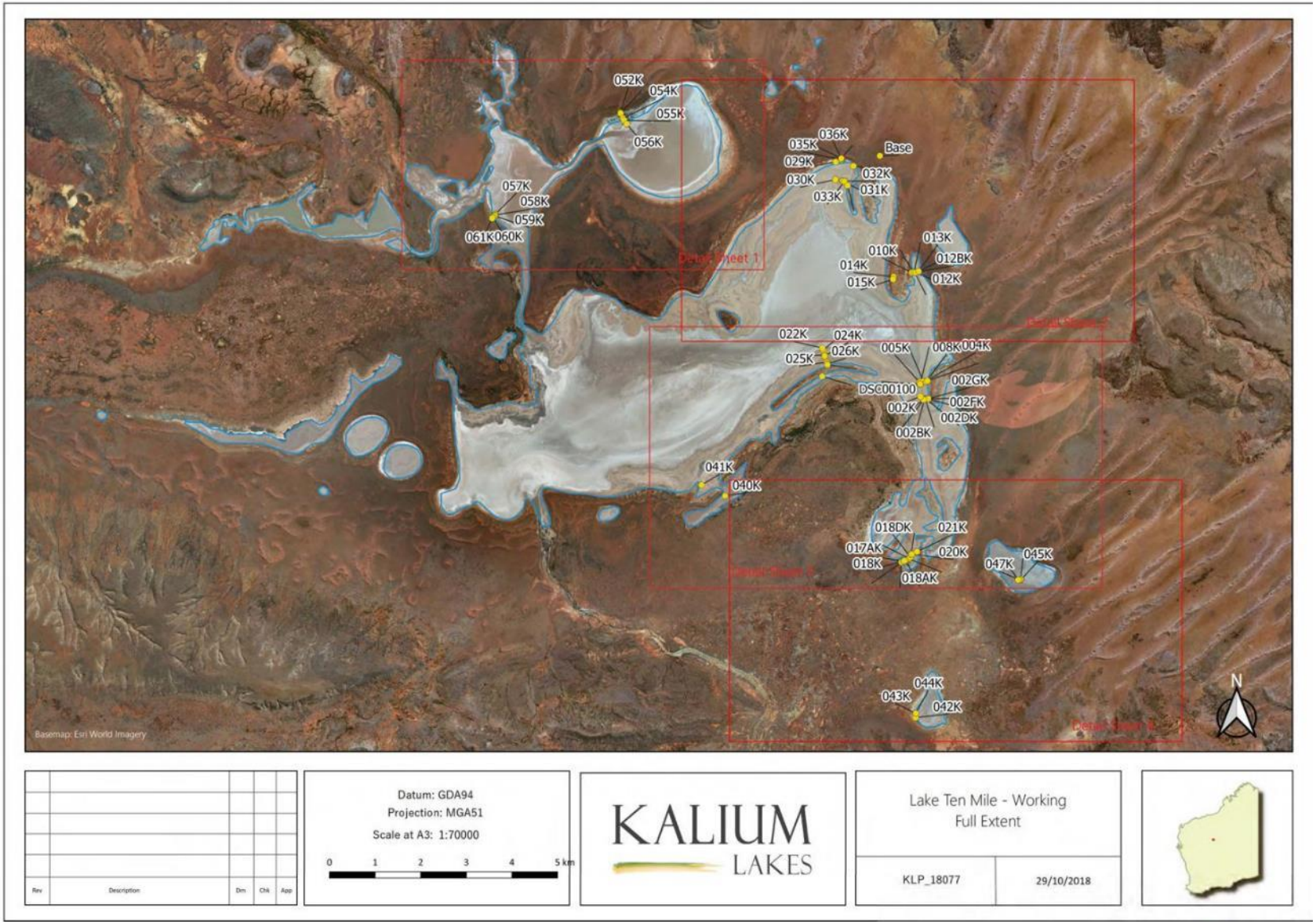

Figure 121 – Way Points Ten Mile Lake, Ten Mile Sth Lakes 1&2 and Beyondie Lakes, *actís* Survey

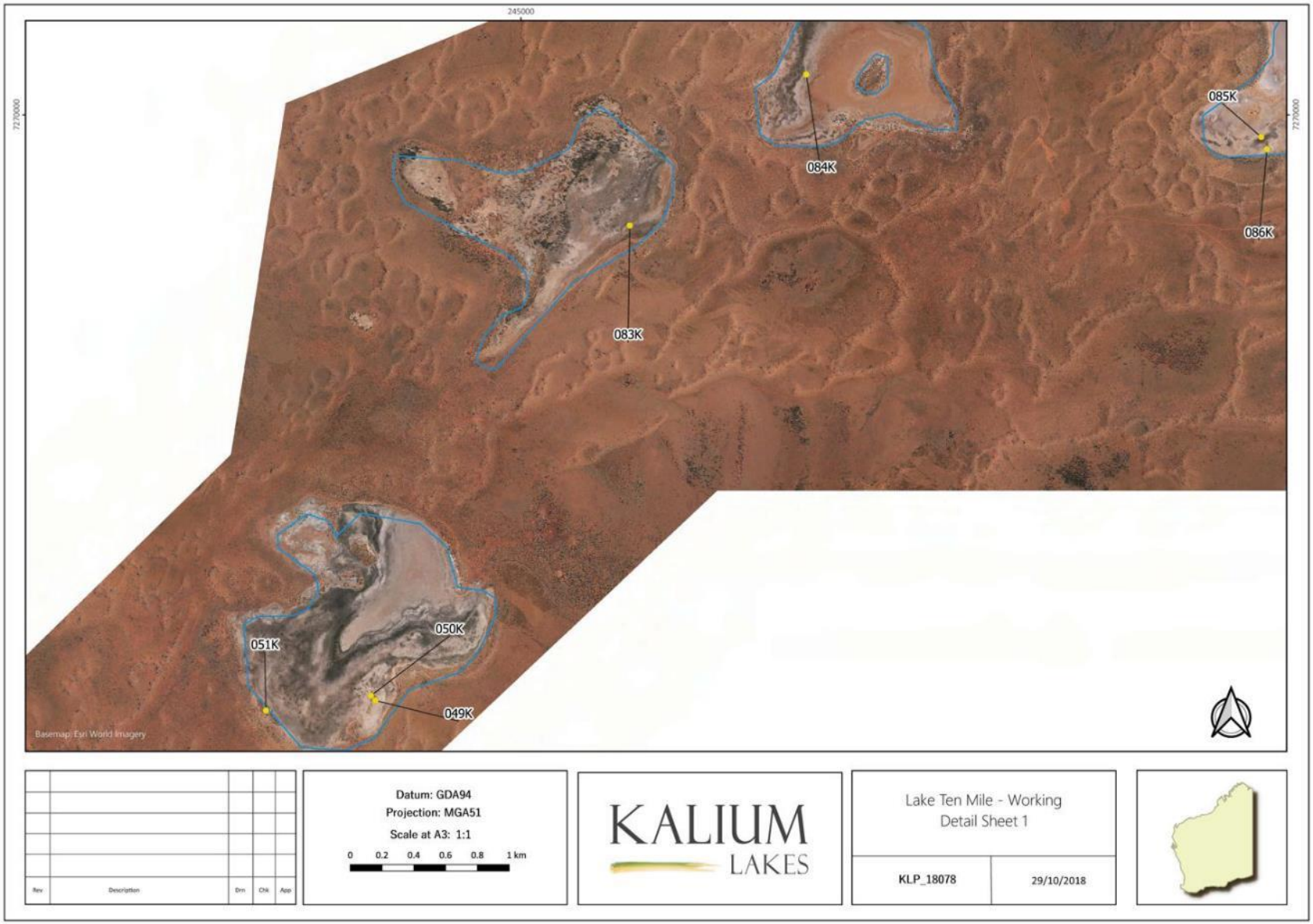

Figure 122 - Way Points Sunshine Concentrator Lake (bottom left), and Vegetated Lakes #1 and #2, *actís* survey

Figure 123 - Way Points Lake Sunshine First (L) and Second (R) Transects, *actís* survey

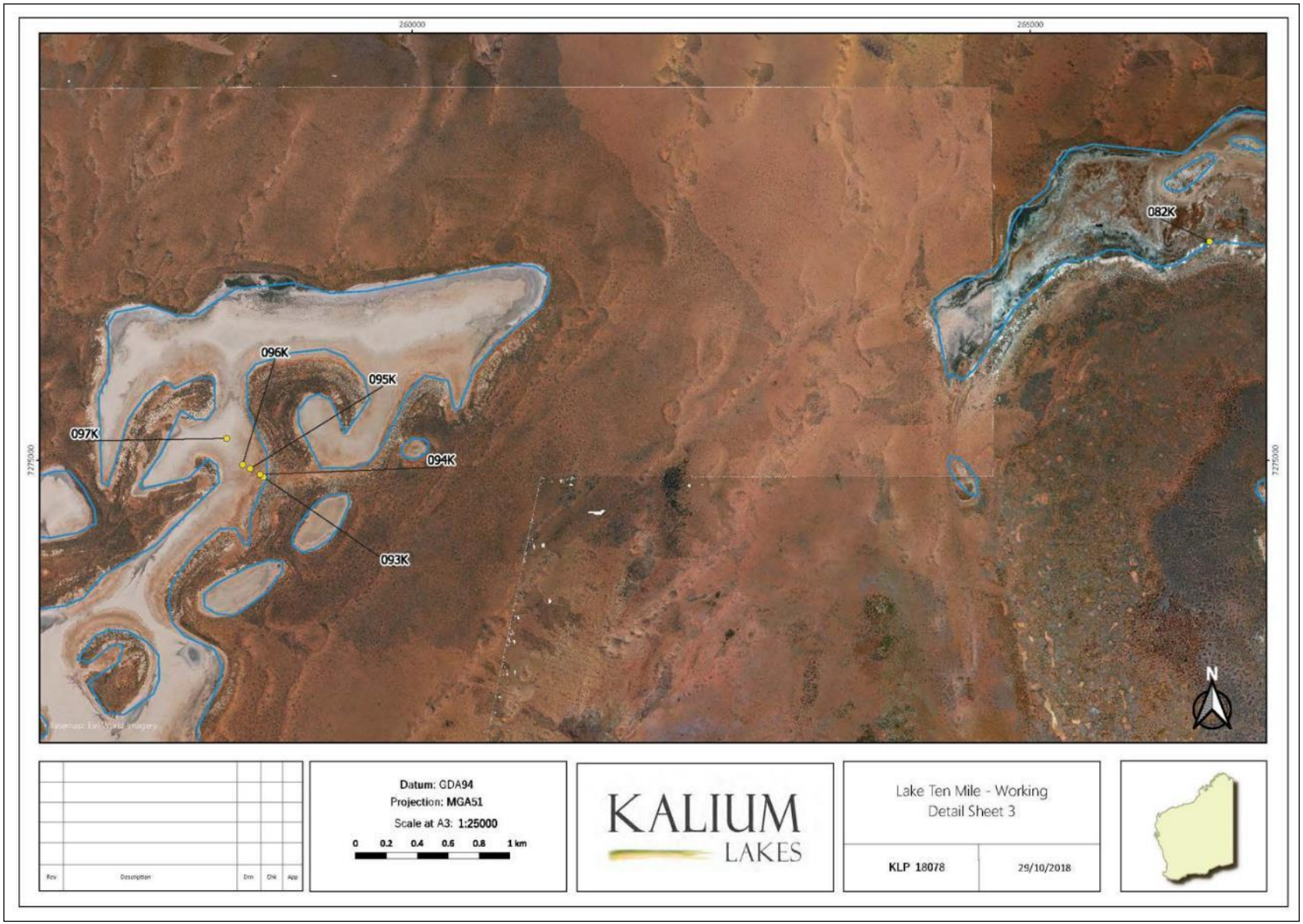

Figure 124 - Way Points Lake Sunshine Third Transect plus Nth Sunshine Lake west, *actís* survey

Figure 125 - Way Points North Sunshine Lake, *actís* survey

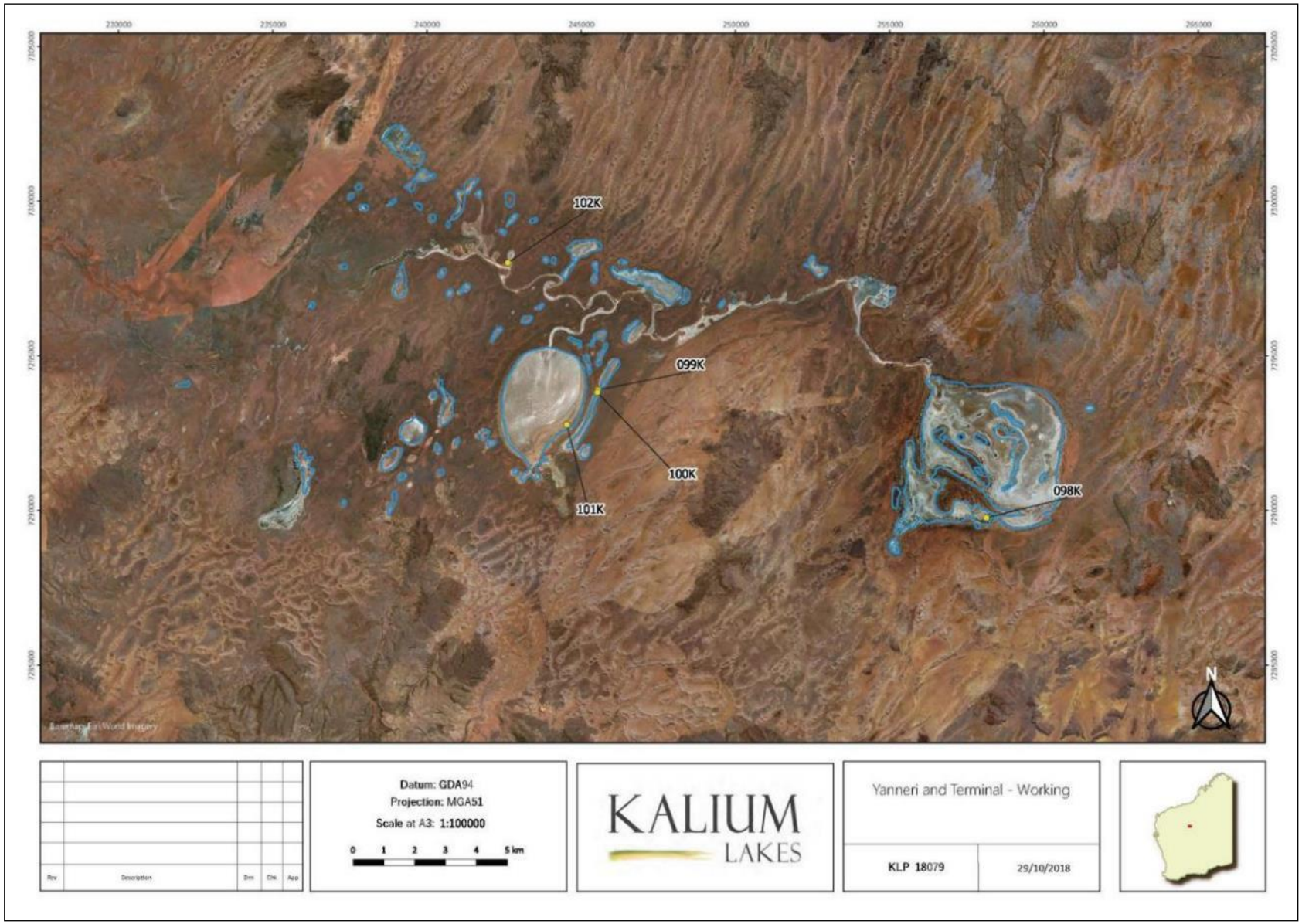

Figure 126 - Way Points, Yannery Lake (L) and Terminal Lake, *actís* survey

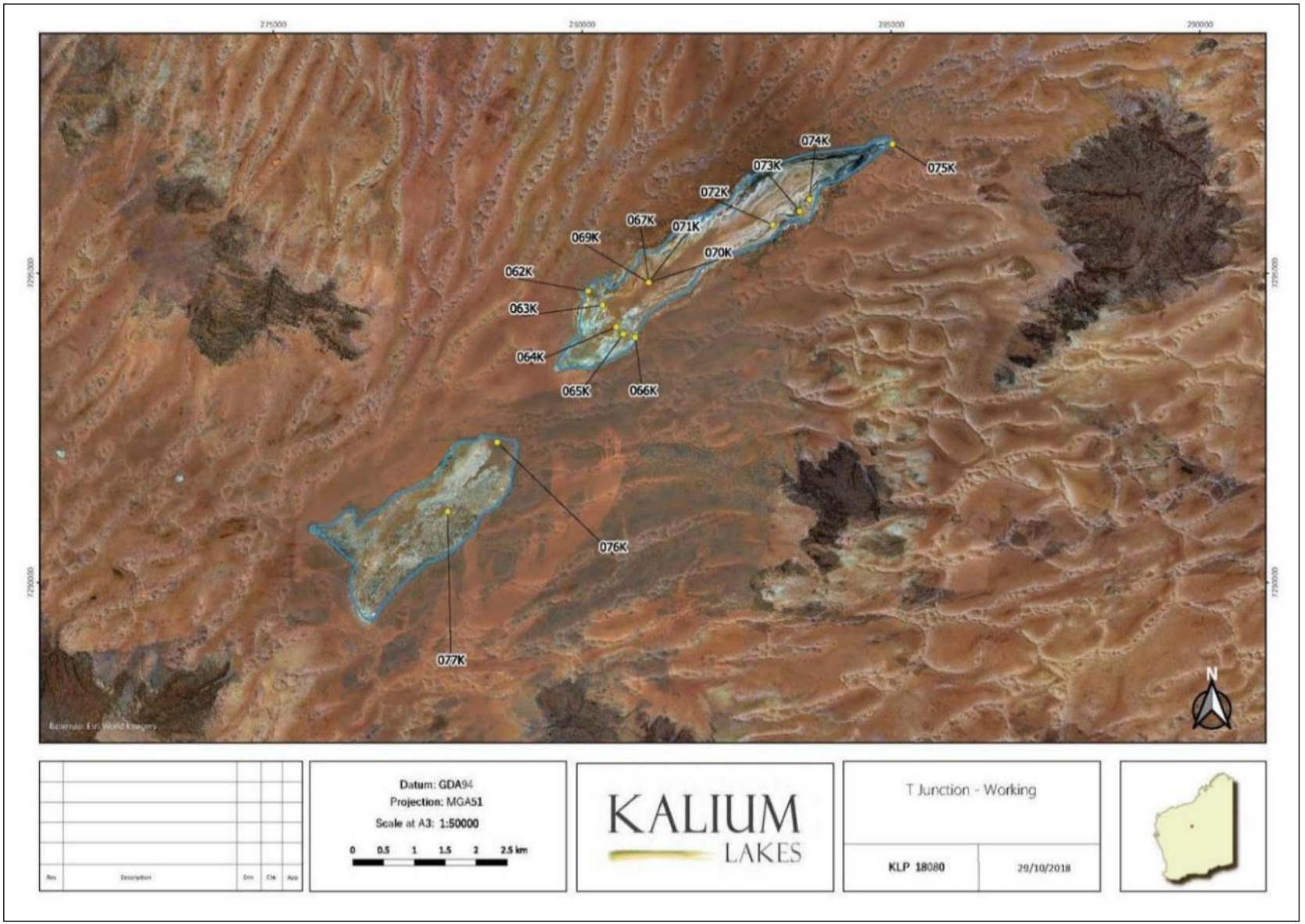

Figure 127 - Way Points T Junction and South Junction Lakes, *actís* survey

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